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THE ELECTRICAL WORLD

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CONTENTS.

	PAGE.
ILLUSTRATED ARTICLES:	
The Continental Dynamo	2
Elastic Foundations for Dynamos	2
The Manufacture of the Cobb Vulcanite Wire	3
The "Triumph" Automatic Gas Burner	5
The Baker Common Sense Oil Filter	5
Six Years' Practical Experience with the Edison Chemical Meter. By W. J. Jenks	6
CORRESPONDENCE:	
Why Gas Main Conduits Are Safe	10
EDITORIAL PARAGRAPHS	1
MISCELLANEOUS:	
Electrical "Scrap Books." By S. G. Shanks, M.D	2
Keeping an Electrical "Index Rerum." By A. H. A	2
Statistics of Wires in Brooklyn	3
West Indian Cable Service	3
Duel by Electricity	4
The St. Louis Telephone Decision	4
The Mexican Telegraph Company	5
American Engineers and the Paris Exposition	5
Fares to the Chicago Electric Light Convention	5
The Electrolysis of Common Salt	5
The Operation of Coal Mining Machines by Electricity	6
The Sellon-Julien Interference	10
The Provisional Programme of the International Electrical Congress of 1889	10
SPECIAL CORRESPONDENCE:	
New York Notes, 11; New England Notes, 11; Philadelphia Notes, 11; Western Notes, 12; English Notes	12
DEPARTMENTS:	
The Telegraph, 12; The Telephone, 13; The Electric Light, 13; Applications of Power, 13; Personals, 13; Business Notices	13
Our Illustrated Record of Electrical Patents	14

Beginning the New Year.

IN the last issue of 1888 an announcement was made with regard to the formation of the W. J. Johnston Company, Limited, by which THE ELECTRICAL WORLD and the allied enterprises would thereafter be carried on. The arrangement then spoken of has duly gone into effect, and in issuing the first number of the paper under the new auspices, we take the opportunity to say that the policy of THE ELECTRICAL WORLD and the spirit animating all its actions will, like its personnel, remain the same. It will be our endeavor and intention to conduct the journal with the independence and integrity that have hitherto characterized it, and with even more activity than before in keeping it abreast of the great electrical developments of the age. No pains and no expense will be spared to render it comprehensive and complete, and we think that the improvements made in the present number may be taken as an earnest of the efforts that will be put forth to publish everything as fully as possible that interests or concerns our readers. Although we shall continue to add to the number of our reading pages whenever the occasion requires, we have provided for the regular inclusion of more matter by adopting new and smaller, though not less legible type, for a large part of the contents. We have also increased the weight and improved the quality of the paper used, so that the journal gains at once in the quantity of its matter and in its appearance. Various minor changes have, moreover, been made, seeking for their one end the benefit of the readers and advertisers, who, we are satisfied, will appreciate, as they have before so generously, the efforts made to reach perfection. It is, perhaps, almost needless to remark that all these improvements require an additional outlay, which assumes considerable proportions when multiplied fifty-two times, but our experience warrants us in the faith that they will bring what is desired—a marked extension of the paper's influence and usefulness.

Expiring Patents.

IN order to add to the value of our Illustrated Record of Patents, we have begun in this issue a supplementary record of expiring patents. This will appear regularly from week to week, and will be worth following by all interested in patents and inventions.

Insulated Wire Manufacture.

IN few fields has as much activity and ingenuity been shown of late years as in that of insulated wire manufacture. It is true that our factories have not yet had occasion to turn out much ocean cable, but in all other departments of their industry they have been remarkably progressive. This week we publish an illustrated article on one of the latest departures in this line, one giving excellent promise of noteworthy results, and involving no small skill and originality in the details of manufacture. The difficulties attendant upon the production of an insulated wire of the class in question are by no means few or insignificant, and our readers will be interested in learning how they have been met.

Bids Wanted.

A RECENT little incident in the Indian Territory explains why the West is "great" and why it grows so quickly. It will be well-known to our readers that the Oklahoma "boomers" have for some time past been trying to settle in the Territory, but have been hindered by armed force. In the present instance, their advanced guard got a start of 36 hours. During that time they had marked out a new town, laid out the town lots, and divided the ground among themselves. When they were seized, they were holding a town meeting and were considering a proposition to advertise for bids on an electric light plant. Evidently the electric light stands high in the scale of things which the western settler holds to be necessary. We hope that when the "boomers" at last get a town they can call their own, they will have a first-class plant, such as their enterprise deserves.

Gas Mains as Conduits.

THE recent description in our columns of the running of electric circuits in gas mains aroused the fears of a correspondent, lest the formation of a spark or arc might cause an explosion of the gas. As another correspondent points out this week, there is no danger to be feared from this source, for obvious reasons. In fact, the presence of the gas may be looked upon as an element of safety. It is well known that carbon is deposited on bodies when they are raised to high temperature in hydrocarbon gas, the process of "flashing" incandescent lamps being based upon this fact. It follows, therefore, that an arc or spark in a gas conduit would, in the first place, entail no danger, but its continuance would be impossible, as carbon would at once be deposited on the heated surfaces and the break soon bridged by a carbon deposit. The arc would therefore be its own extinguisher.

Street Railway Traffic.

THE returns of the eighteen horse car and one elevated roads operating in this city have just been made to the State authorities and are full of suggestive figures. It appears that 376,913,586 five cent fares were paid last year, and that the equipment of the roads comprised 3,203 cars, 13,458 horses and 291 locomotives. Leaving out the elevated railway's figures, the eighteen horse car roads are found to have 2,133 cars and 13,586 horses, with which they give transportation to 205,383,797 passengers. If those passengers were canvassed, very few of them would vote for a continuance of the present horse service, which is so unsatisfactory and slow; and if those who used the elevated road were given a like opportunity to express their opinion they would be not less emphatic in their wish for something that would actually approximate to "rapid transit." Those parts of the city where the big car stables are situated would certainly be healthier if the 13,586 horses were dispensed with and replaced by electric motors, and we believe that in the adoption of electricity will be found the whole solution of the municipal transit problem, now so pressing.

A Kindly Word.

WE are in receipt at this season of a number of kindly expressions in regard to the paper, from old readers and others, and would be glad, if space permitted, to print a few of them. Their nature may, however, be judged from the following, which we venture to quote as in every way representative. The writer is a leading New Englander, president of at least a dozen companies, and so busily engaged that it has always been a matter of wonder to us how he could keep informed as he does of all the latest developments and applications of science. He says: "It is my stated and invariable duty to go carefully through every number of THE WORLD. In one respect your journal is almost unique; that is, in the judicious selection of topics. I always count on finding in its columns everything in the electrical sphere that is worth knowing, and that without being obliged to go through a mass of unimportant matter and winnow out heaps of chaff in order to possess myself of the grain." The editor would be hard to find who did not derive encouragement and stimulus from such voluntary commendation as that.

Foundations for Dynamos.

WE have in the past noted more than one case of the bringing of suits by parties located in the neighborhood of electric light stations, in which the noise and vibration due to the engines and dynamos were complained of as a nuisance. In some cases, the operation of the stations in the vicinity of populated neighborhoods has been stopped from this cause. Again, with the increasing number of isolated plants introduced into residences and hotels some means of preventing, as far as possible, vibration due to the driving of electric light machinery seems desirable. This evil is one which depends largely on the foundation on which such machinery rests; for, with sufficiently heavy and deep bases, machines can be run without disturbing surrounding objects at all. The usual mode of construction, however, can rarely be applied in isolated plants which have not been previously designed for the introduction of such machinery, and the knowledge of a convenient method of overcoming the difficulty may be a means of determining the introduction of such apparatus. Our description, therefore, of a method successfully introduced abroad will prove of interest, and as the same idea may be easily carried out here, we have given space to it in our columns this week.

Electrolytic Meters.

ALTHOUGH the most extensively used of all electric meters, there is probably none about the details of which so little is known among the rank and file of electricians as the electrolytic form adopted by Mr. Edison. The cause for this may be sought in two directions. It is probably due to the reticence which has heretofore been manifested on the part of those employing the meter; and, on the other hand, it may be looked for in the circumstance that the electrolytic meter made its appearance at an early date in the new art of electric lighting, when the present generation of electrical engineers had hardly entered the field: and as a result the electrolytic meter, though in extensive use, has, as it were, been lost sight of in the avalanche of later devices intended to answer the same purpose. What may therefore be considered as the first authoritative statement regarding the Edison meter, in actual practice, is that detailed in the admirable paper read before the American Institute of Electrical Engineers by Mr. W. J. Jenks. Mr. Edison, recalling the fact that the distribution of gas for illuminating purposes failed of commercial success until a meter had been invented, recognized that the same principle held good with regard to electric lighting; and the first work which he undertook after the perfection of his lamp, was the devising of a meter which should measure the current consumed on the premises of each subscriber. Of the many principles on which an electric meter can be based, Mr. Edison seems to have tried all which gave any prospect of success, and finally he adopted the one now in use. This search after a good meter is well illustrated in the description contained in Mr. Jenks' paper of a variety of forms, mechanical, electrolytic and other, containing combinations of different principles in their action. With the evident desire to forestall the criticisms which are usually made on the electrolytic meter, Mr. Jenks introduced into his paper an enumeration of the sources of error due to change of temperature, counter E. M. F. at varying current strengths, and variable resistance, and showed in what manner these were provided for in the Edison meter. Not the least valuable part of the paper is the testimony of those using the meter relating to its effectiveness in actual practice. On this point the opinion seemed to be unanimous that, so far as accuracy is concerned, the meter leaves little to be desired. And it is also shown that upon the score of expense of maintenance there seems to be a limit, as regards the number of the lamps connected to a station, below which the metering system is not so profitable as the contract system. It is further shown that above this limit of lamps the addition of a meter to the system has a most marked effect in the decrease of consumption of current, and at the same time in a more than proportionate increase of revenue due to the fact that while under the contract system consumers are apt to use more light than is necessary, under the meter system they uniformly take care to turn out every lamp that is not absolutely required. The paper of Mr. Jenks throughout is well considered in every detail, and we advise its perusal by all who are interested in the distribution of current for all purposes.

Electrical "Scrap Books."

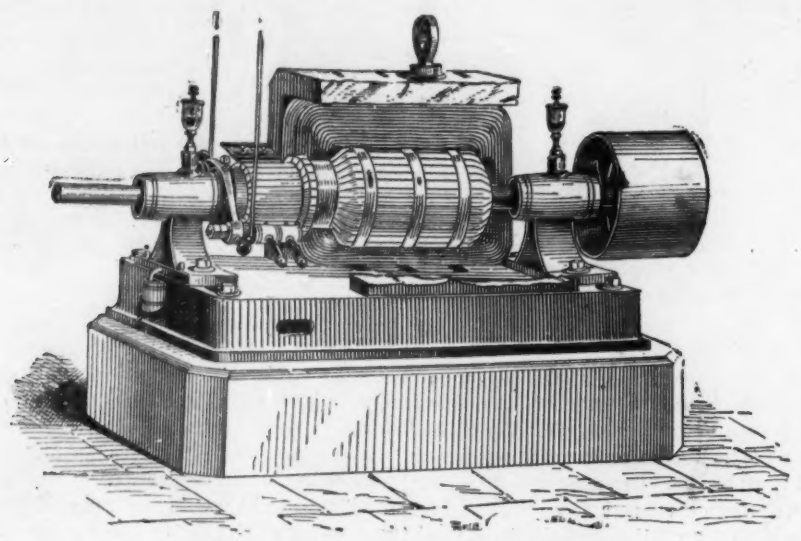
BY S. G. SHANKS, M. D.

I have for years kept a scientific scrap book like the electrical scrap book of H. F. Watts, described in THE ELECTRICAL WORLD of Dec. 22. Whole pages, scraps and pictures from the WORLD, *Scientific American* and other journals are used. I try to keep the subjects together as much as possible. "Ammeters and voltmeters," "batteries," "dynamos," "electrical welding," etc., are so grouped. As material accumulates, there may be several groups of one subject—as of "batteries." The smaller scraps and cuts are usually slipped in between the large leaves near their proper subjects, and are fitted and pasted in at leisure, to cover irrelevant matter, thus making the groups as nearly as possible "solid." A card catalogue or index is started with the scrap-book and is all-sufficient. One of my filled books—a "Monitor" binder—has 540 pages. The index comprises 27 cards. There is one card each for the letters A, B, C and D; one card for E; also one for "electrical measuring apparatus," and one for "electrical machinery," etc. Subjects are entered in the index on two or three cards, if possible, for ease of reference—as "Electrical Current, M. Forbes, (page) 344;" "Forbes Current Meter, 344." I watch for late comprehensive articles to slip in the place of early crude subject matter. Valuable scraps or cuts can be soaked off and repasted in, and the card index corrected. Flour paste is much better than mucilage. It does not strike through the paper. For index I use large size blank cards, about 3¾ × 2½ inches, obtained in packages at paper warehouses.

To illustrate my method: Opening the alphabetical index of my note book at "I," I find "Influence of Wires Carrying Heavy Currents on Wires Carrying Light Currents, ELECTRICAL WORLD, Aug. 9, 1888, page 90." Turning to page 90 I find merely the "following conclusions," embodying the last three paragraphs.

I abbreviate the common electrical terms, and it is as tonishing how short, yet sufficiently complete to get the essential points, a review of an article can be made.

In preparing my files of THE ELECTRICAL WORLD I take out the advertisements, except the first issue of each month, which remains intact, and my idea in so doing is that the advertisements show to a large extent the progress and development of the electrical business; and I will therefore have an interesting yet not too bulky résumé.



THE CONTINENTAL DYNAMO.

The American District Telegraph Company.

President Thomas T. Eckert, of the American District Telegraph Company of New York, reports for the year ending Sept. 30:

Authorized capital	$3,000,000
Issued capital	2,550,000
Cash surplus, Sept. 30, 1887	25,020
Gross earnings, 1887-8	467,048
Expenses and construction	414,650
Net from service	53,197
Other income	17,519
Total net revenue	70,717
Total surplus	95,738
Dividends paid	73,500
Balance surplus	22,238

The treasury assets include 22 bonds of the Philadelphia company worth $2,200, 700 shares of the Baltimore company worth $3,500, 1,760 shares of the Boston company worth $44,000, 250 shares Cleveland company worth $5,000, 175 shares Holmes' Electric Protective Company worth $175,000, 1,000 shares Manhattan District Telegraph Company worth $100,000. All of the above are at their par value. The company has 826 miles of wire in operation, 58 offices, 19,051 instruments, 978 messengers and 80 other employés.

Keeping an Electrical "Index Rerum."

BY A. H. A.

I read with considerable interest Mr. Watts' article, "Electrical Scrap Books," and as correspondence is invited from those who "when found make note of" I will briefly state my method. The editorial suggestion, an "Index Rerum," is the one adopted by me, with the addition that any article that is of particular interest or may be of use to me, I write a synopsis of or embody in as few words as possible the results arrived at by the author.

As I am "on the road," as the expression runs, it would be inconvenient to carry complete files with me, or even a "scrap book." By my system I have the essence of the latest thought and progress in electrical science at hand in a small note book. Moreover, the writing out of the synopsis tends to impress the facts upon my memory, and I fancy I do not spend any more time in so doing than Mr. Watts does in cuttting out and neatly pasting the article into his "scrap book."

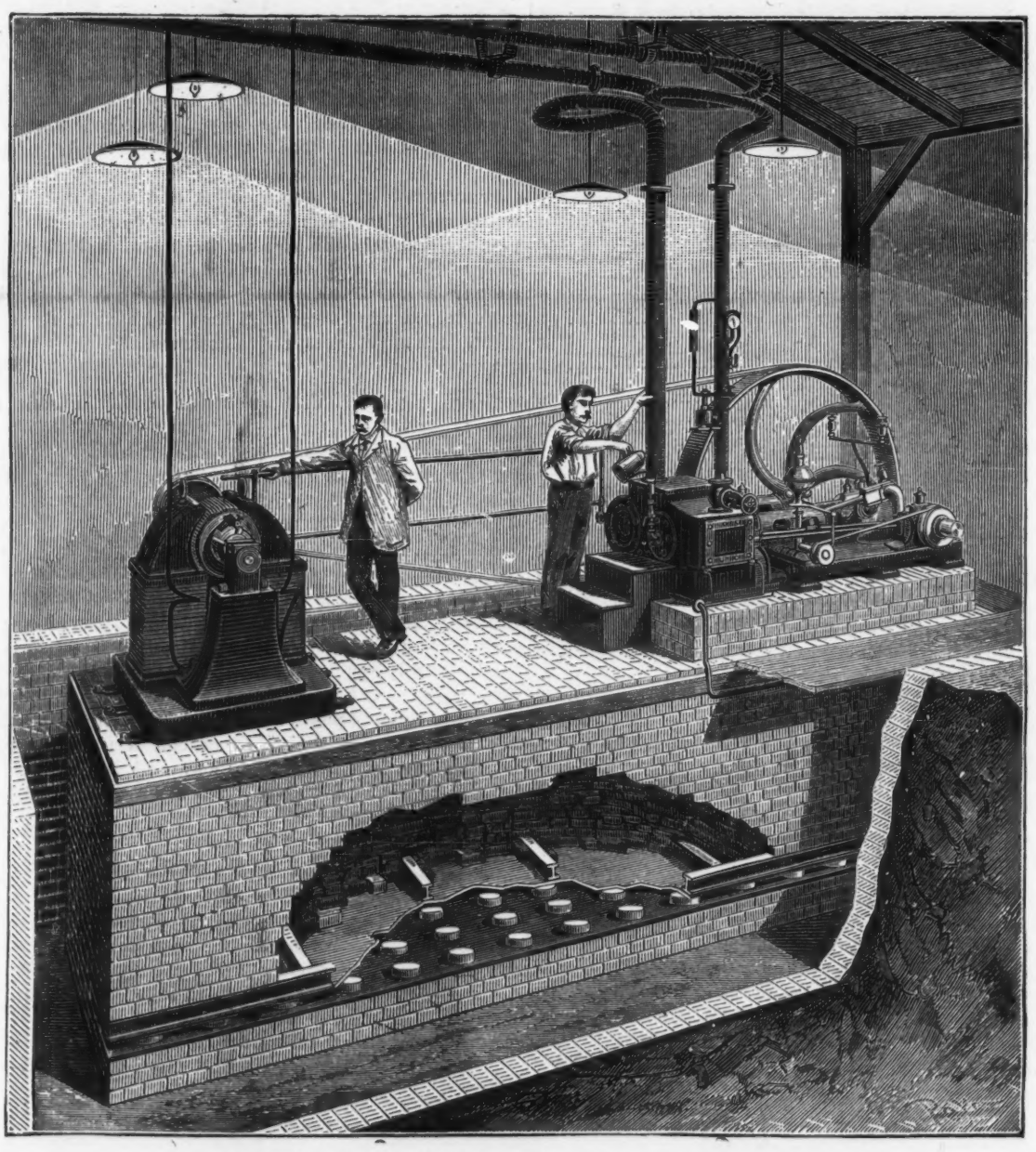
The Continental Dynamo.

Our illustration represents in section the dynamo now being built by the Continental Dynamo Company, of this city. It will be seen that the form of the magnet frame, as well as its construction in a single casting, constitutes the characteristic feature of the machine. Considered from the electrical standpoint, the form chosen enables the constructors to obtain a perfectly symmetrical shape for the electro-magnets, the poles of which are presented to the armature in such a way that the magnetic lines of force are concentrated upon the armature with practically no loss, as the magnet is without pole piece, and projects end on against the armature with but a small air space. As the whole magnetic frame consists of but a single casting, the construction of the machine is thereby considerably cheapened, and the magnet coils, separately wound, are slipped on to the internal cores.

The machine, on account of its simplicity, can be taken apart with very little trouble by removing one of the journal bearings, and the magnet coils can be slipped off, and the machine is then practically open for inspection in all its parts. These dynamos are built both shunt and compound, and range in capacity from 30 to 1,200 sixteen c. p. lamps. A number of these machines which have been installed in various parts of the country, seem to have given excellent satisfaction.

Elastic Foundations for Dynamos.

As dynamos and steam engines are being introduced more and more into private houses and in neighborhoods where the vibration occasionally accompanying their operation is objectionable, some means for preventing the trouble is of special interest at this time. Various forms of foundations have been proposed for this purpose, very few of which, if any, have proved satisfactory. In a recent communication to the Société des Ingénieurs Civils, M. G. Anthoni describes a method of overcoming the difficulties caused by vibration and noise from engines, and the point upon which he lays particular stress is, in the case of machinery, the increase of the mass of the system to be isolated and its carriage by an elastic body, such as rubber. Our engraving, taken from *La Nature*, illustrates an installation recently designed by M. Juppont, electrical engineer to M. Pulsford, and erected in the suburb of St. Denis, near Paris. Before the erection of this foundation the vibration of the machine and engine was considerable, and several lawsuits seemed imminent at one time, but since its installation all trouble has disappeared.



ELASTIC FOUNDATIONS FOR DYNAMO PLANTS.

As will be seen in the illustration, a large trench is dug out, at the bottom of which is placed planking surmounted by a covering of sheet iron, on which are distributed a number of rubber cylinders, constituting at the same time an elastic and electric insulation. On top of these cylinders there is placed a second plate of sheet iron, riveted to a framework so as to give stiffness to the whole. On this is built a foundation in the usual way, provision being made for the foundation bolts and sufficient space being left to properly allow of periodically cleaning the

trough of any extraneous matter, without disturbing the elastic suspension. The foundation need not be of masonry, and in some cases it might be advantageous to replace it by a caisson filled with sand, which may be easily transported. The trench surrounding the foundation is covered at the top by a plank forming a border, but so as to allow of horizontal movement. The steam and exhaust pipes are given a spiral turn at their upper ends so as to permit of their being elastic under the movement which takes place, and so as to avoid the springing of joints. In the particular case illustrated, the oscillatory movement is eight millimetres, and nothing is more curious than to see this whole mass, which weighs more than twenty-five tons, rapidly vibrating without one being able to feel the slighest vibration even at the edge of the trench.

Statistics of Wires in Brooklyn.

The annual report of President George W. Plympton, of the Electrical Subway Commission, shows that there are now 2,928 miles of conductors under ground. This includes a little over seven miles of cables, attached, under temporary permits, to the elevated railway structures. Of the aggregate of 5,117 miles of aerial conductors now reported, those of the District Telegraph companies and of the Gold and Stock Telegraph Company occupy housetops and not poles. Of these the report says: "Since there has appeared to be no method of concentrating their small but scattered mileage in conduits, which would not be at once destructive to their business, the board has continued to permit their operation above ground. The wires of the Metropolitan Telegraph and Telephone Company occupy a limited territory, mostly along the water front. It has not been deemed practical to require the construction of conduits for the small mileage which they require.

"Nearly all of the 236 miles of the telegraph wires now carried on the poles will be removed within the next few months. There were 317 poles removed during the year 1888. The board looks with satisfaction upon the prospect of the introduction of the incandescent system on a large scale in Brooklyn, believing that it will prove a public benefit."

During the past year the New York and New Jersey Telephone Company has taken down 714 miles of wires, the Western Union Telegraph Company 20 miles, and the electric light companies 50 miles. The commissioners estimate that over 800 miles of overhead wires will have been removed by the first of the year. Previous to Jan. 1, 1888, only 600 miles had been removed.

Although there are 2,871 miles of telephone wires in the conduits, only 1,565 miles of them are in use, the reason for which, the report says, is the practice of laying the cables, not for present but for prospective business requirements.

The commissioners propose to introduce a bill at Albany giving them the power to require electrical companies to place their wires on the elevated roads when possible to do so. Such a bill failed last year.

The question of burying electric light wires, the Commissioners think, is still unsolved, and they think that the serious danger presented by their being unprotected calls imperatively for some system by which they can be placed in conduits.

West Indian Cable Service.

The present situation of affairs in Hayti has directed attention to the condition of the cable service in the West Indies. Although from time to time there has been great anxiety for news from Hayti, none could be had. The New York *Herald* furnishes the following explanation of matters:

Few who have read of the revolution now racking the little Republic of Hayti have been aware that a struggle far more fierce, though bloodless, has been waged, and is still going on, in the West Indies. The conflict referred to is between the new French cable company, the only one whose lines touch Haytian ports, and the other West Indian cable lines, which, it is alleged, are making desperate efforts to "freeeze out" the new company and to get control of the stock, in order to monopolize the entire cable system of the West Indies.

The lines of the new company run from Santiago de Cuba to Mole St. Nicolas, in Hayti, then along the Haytian coast to Puerta Plata, St. Domingo, and thence by a land route across to St. Domingo City on the southern coast. A cable is laid from there under the Caribbean Sea to Curacoa, in Venezuela, and from there to La Guayra. The company depends for the transmission of its messages to the United States and Europe on the West Indian and Panama Cable Company, whose lines extend from Santiago de Cuba to Kingston, Jamaica.

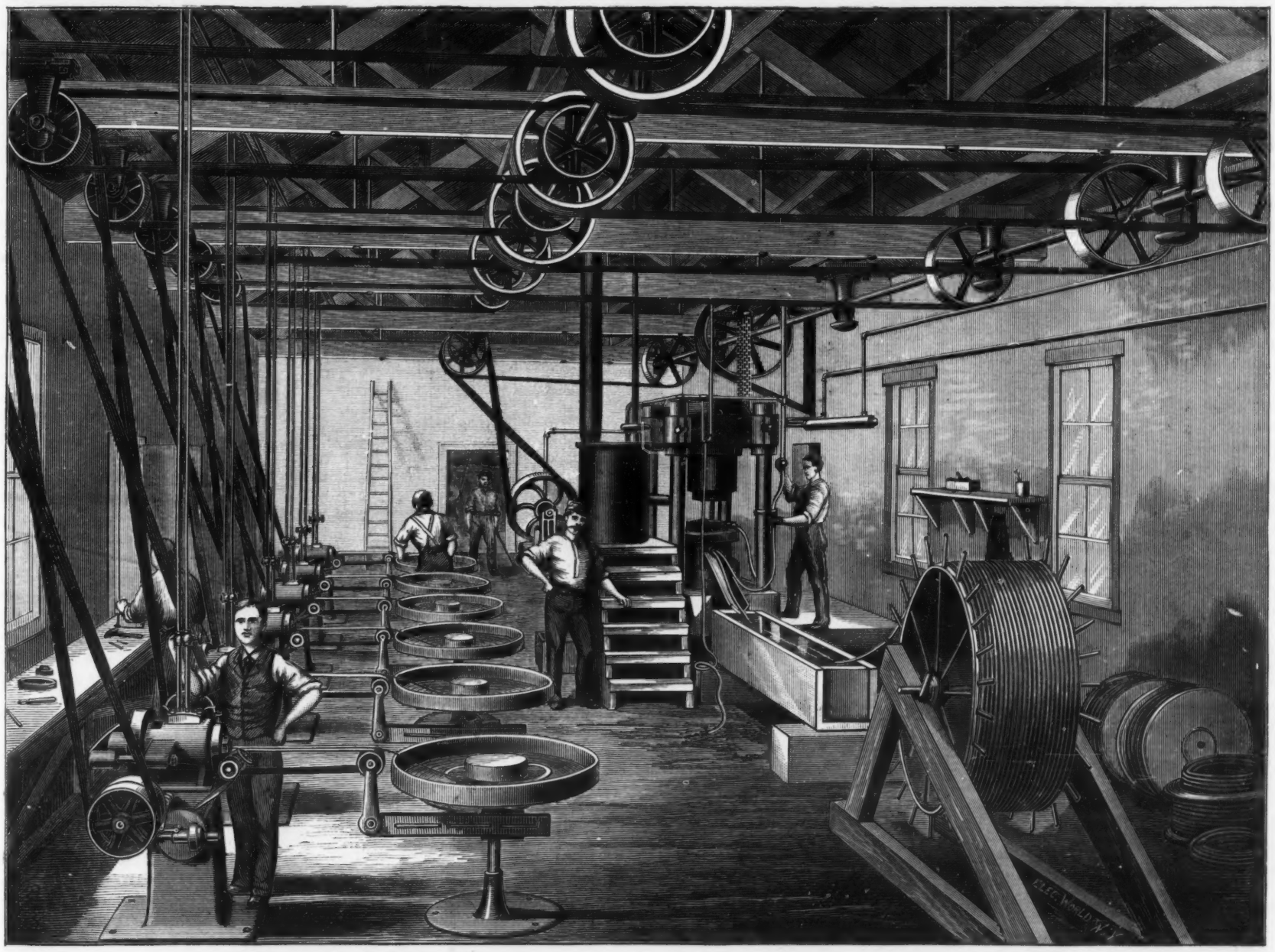
A line laid by the Cuban submarine company after the Cuban insurrection leads from Santiago along the southern coast of Cuba and around to Havana on the north, making also a connection with Cienfuegos, Cuba, on the way. The International Telegraph and Ocean Company own the cables from Havana to Key West and Punta Rassa, Fla., and control the one from Kingston to Porto Rico and running along the group of Windward Islands to Trinidad, though the Panama company controls the line, as it also does the Cuban submarine line. This company, which is granted a subsidy of £2,000 per year by the Jamaican government, claims the exclusive right to land its cables on Cuban soil, and hence refuses to receive from or transmit any messages to the new company. The Cuban authorities have seconded this by forbidding any messages to be transmitted from the English lines.

Thus it is that while trouble has been brewing in little Hayti, little news by cable from Mole St. Nicolas, one of the northern strongholds, has been obtainable. Further, it is said that the Western Union, which has a controlling share in the I. O. T. company, is backing the combine with the expectation of finally controlling the entire West Indian network of cables and finally building a connection with the Brazilian cable at Rio Janeiro.

The Manufacture of the Cobb Vulcanite Wire.

Although the qualities of hard rubber tubing as an insulation are well known and have stood the test of time, the employment of such an insulation for wires has heretofore been very limited on account of the difficulty of manufacture where long, continuous lengths of conductors, free from joints, are required. This difficulty has, however, been recently overcome by a process of manufacture, invented by Mr. H. B. Cobb, and now employed largely by the Cobb Vulcanite Wire Company, who have recently established extensive and well equipped works at Wilmington, Del., as described by us recently. This insulation consists of flexible hard rubber, the rubber being vulcanized so that it is not burned, but though hard, is flexible and capable of being bent at any angle. During the process the insulation is subjected to a pressure of 75 pounds to the square inch, which solidifies it and removes all the air holes. The wire is then inserted into these long lengths of tubing by a special process, and thus lies loosely, though snugly, in it, touching the insulation at but comparatively few points. The high insulating properties of the rubber insulation in the first place, and the smallness of the contact between wire and rubber, combine to make the insulation resistance unusually high, as shown by numerous tests.

The works of the company cover an entire block, and our engraving, Fig. 1, shows the main shop. This contains the lead-cable press at the right, and six rubber tubing machines at the left. These have a combined capacity of over five miles of electric light cable per day, and we may add, are kept running at their fullest capacity.



AN INTERIOR VIEW, COBB VULCANITE WIRE WORKS, WILMINGTON DEL.

On account of the unusually high insulation resistance of the cable manufactured in the manner above described, special arrangements for testing had to be adopted. These are shown in the engraving Fig. 2, which represents the testing room.

The testing apparatus, which was designed for the particular requirements of the company by Mr. Carl Hering, consists of a double coil, astatic Carpentier-Thomson galvanometer *G*, of the most sensitive type. It has 60,300 turns of wire and 16,130 ohms resistance, and is wound with wire $\frac{1}{10}$ millimeter diameter, which is equivalent to about No. 38 B. & S. It was found necessary to insulate this very carefully, and it was therefore supported on three ebonite pillars mounted on paraffined blocks of wood. The deflections are read by means of a telescope *T*, about 7 feet distant, which is therefore equivalent to having a 14-foot pointer on the needle. The telescope is quite large, enabling tenths of a millimeter to be read with accuracy. The porcelain scale above it is illuminated by a row of gas jets immediately under it. This gives a large, clear and distinct view of the scale and cross hairs. The three keys, namely, the galvanometer key, insulation key and capacity key, are to the right of the operator in the engraving, and are all insulated on ebonite pillars, besides being placed together with the galvanometer shunt *S*, and high resistance box *R*, on a large, thick plate of ebonite. These precautions for insulation were found necessary, as the leakage from the instruments was otherwise found to be about as great as that through the cable to be tested. *C* is the condenser, made up of .05, .05, .2, .2 and .5 microfarads. *W* is a wire bridge for locating faults.

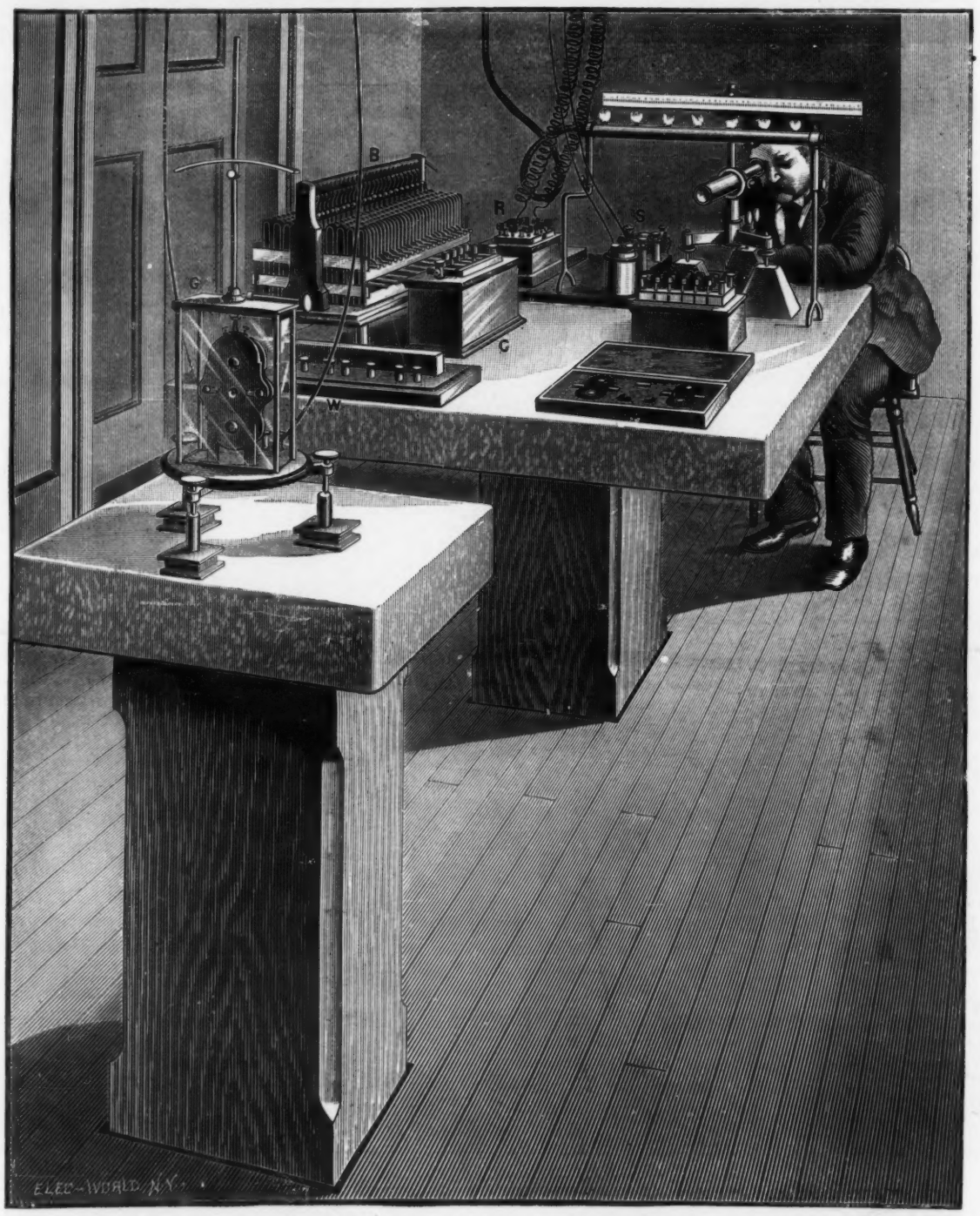


FIG. 2.—TESTING ROOM, COBB VULCANITE WIRE WORKS, WILMINGTON, DEL.

Owing to the extremely high insulation of the wire to be tested, it was found that a very powerful battery was required, notwithstanding that the galvanometer was the most sensitive that could be obtained. A battery was therefore designed especially for this purpose by Mr. Carl Hering. It is shown at *B*, and consists of 200 cells of storage battery of the Planté type, made of thick lead wires. They are connected in 20 groups of 10 cells each to a cylindrical commutator at the top of the apparatus, in such a way that, by merely turning the commutator through a quarter turn it will connect these 20 groups in multiple arc, or all in series. For calibrating the galvanometer they are connected in multiple arc, and for testing it is only necessary to turn the commutator in order to increase the battery potential 20-fold. The internal resistance of the battery is very low, and can be neglected in practice. It is so low that when the 200 cells in series are short-circuited it gives a flash as large as a walnut. When touched by the hand the battery gives a violent shock.

The battery is charged by connecting the groups in multiple arc, and then connecting them to 16 or 20 Leclanché cells kept for that purpose. The acid in each storage cell is covered with a layer of heavy machine oil to prevent evaporation and formation of spray in charging. They are insulated from each other with glass and hard rubber rods. Notwithstanding the care in insulation it was found absolutely necessary to support it on four high pillars of ebonite, as there would otherwise be a very perceptible leakage. The E. M. F. of the battery is about 450 volts.

This apparatus was designed for measuring about 50,000 megohms, but under favorable conditions it will measure as high as 100,000 megohms. The insulation of the leads is as perfect as could be made, and consists of vulcanite-covered wire made by the company, which tested 10,000 megohms per mile in water after 19 days' immersion. These are supported on long pieces of ebonite tubing stretched across the room.

Faults are located by the "loop method," with a properly proportioned bridge wire of low resistance, and with the battery shown in the cut. This method is used not only because of the great accuracy obtainable, but chiefly because the resistance of the fault is generally great as compared with that of the comparatively short, thick copper wire. This method eliminates the resistance as well as the counter E. M. F. of the fault.

With a provisional half-meter bridge wire a dead fault was located in a piece of heavy electric light cable 1,867 feet long. The test located it at 23.5 feet from one end and on cutting the cable it was found to be at 24 feet 7 inches, or an error of only about 1 foot in a length of 1,867 feet, which is remarkably accurate. The galvanometer deflection showed that if the bridge wire had been longer, or if the fault had been nearer the middle of the cable, still greater accuracy could have been obtained, which, however, would not be necessary.

In addition to the high insulation resistance, the wire also shows remarkably low inductive capacity, due probably to the fact that the wire is not in continuous contact with the insulation. We append below a record of tests made by Mr. Carl Hering:

Electric light wire, reel No.	Feet.	Insul. res., megohms.	Capacity, microfarads.
16	1,652	66,800	.071
17	1,493	69,800	.062
18	1,876	36,600	.080
19	931	69,800	.040
20	1,830	54,800	.072
21	....	Bad.	....
22	1,384	102,000	.055
23	....	Bad.	....
24	1,882	69,800	.075
25	1,830	6,390	*

The fault in No. 21 was located at 319 feet from end *A*, or 571 feet from *B* end.

It may be added that reports of a very encouraging nature have been made on the Cobb wire by Prof. Houston, Supt. J. P. Barrett, of the Electrical Department of the City of Chicago, Mr. J. F. Mehren, electrician of the Chicago Fire Department, and others.

Duel by Electricity.

The following are the terms upon which Mr. Harold P. Brown has offered to have an electrical duel with Mr. George Westinghouse, Jr.:

"I challenge Mr. Westinghouse to meet me in the presence of competent electrical experts and take through his body the alternating current, while I take through mine a continuous current. The alternating current must have not less than 300 alternations per second (as recommended by the Medico-Legal Society). We will begin with 100 volts and will gradually increase the pressure 50 volts at a time, I leading with each increase, each contact to be made for five seconds, until either one or the other has cried enough, and publicly admits his error. I will warn Mr. Westinghouse, however, that 160 volts alternating current for five seconds has proved fatal in my experiments, and that several men have been killed by the low-tension Jablochkoff alternating current."

The St. Louis Telephone Decision.

The following is in substance the opinion handed down by Judge Black in the case of the city of St. Louis against the Bell Telephone Company, and noted briefly in our columns last week. He holds that the poles, wires, fixtures, etc., of the company are private property but devoted to public use, and that the rights and privileges which the company enjoys as a public corporation make it subject to public regulation. He takes it for granted that the State has the right to fix and prescribe a maximum rate for telephone service. This power could be delegated to a municipal corporation. The ordinances of St. Louis must be in conflict with the general laws of the State. A telephone company, when once its wires are stretched over the streets of a city, becomes in effect a monopoly, and the company must submit to such reasonable regulations as the municipal corporation has power to prescribe. The important question is whether the city of St. Louis had the power to enact the ordinance in question — the power to fix reasonable maximum charges for telephone services. Nothing to the contrary being shown, it is assumed that the fixed rate is reasonable, so that the question is narrowed down to one of power on the part of the city to fix telephone rates at all. If the city has such power it must be found in a reasonable construction of its charter. The city claimed the right to fix rates under the general power to regulate the use of streets. This power is held to extend to new uses as they spring into existence. The erection of telephone poles and stringing of telephone wires is a new use and a proper use of the streets, subject to reasonable regulations. These regulations have been obeyed. This power, however, has nothing to do with fixing charges, which is neither included in nor incidental to the power to regulate streets. The ordinance cannot be upheld on any such grounds. Does the power to regulate telephone companies, coupled with the power to license and tax, give the city the power to regulate the charges for telephone services? Express powers given to fix certain rates for carriages, street railways, gas, etc., were not intended to be given in other cases. The power to license, tax and regulate is not power to fix charges. If the city has the power to do this it may also fix the rate for telegraph services and other designated services of a public character. The claim that this power was granted under the "general welfare" clause of the charter is denied, for the reason that the charter points out with particularity those cases in which the city may exercise the power to fix rates. The only regulation authorized under the "general welfare" clause is a police regulation. For these reasons this ordinance is held invalid, and the case reversed and remanded.

A New Submarine Cable.—Advices from the Bermuda Islands say that a company is about to lay a submarine cable from the islands to Halifax, Nova Scotia. The British government have agreed to pay a subsidy of £12,000 a year to the company. The distance from Bermuda to Halifax is about seven hundred and fifty nautical miles, or about one hundred miles more than to the nearest point in the United States. The work of laying the cable will probably be commenced early in the spring.

The Mexican Telegraph Company.

The statement of the Mexican Telegraph Company for the year ended Dec. 31, 1888, the last quarter partly estimated, is :

Year.	1888.	1887.	Increase.
Earnings	$318,081	$268,166	$49,914
Expenses	59,587	58,896	691
Net	$258,493	$209,270	$49.222
Net for 1888			$209,270
Dividends, etc			94,217
Balance estimated			$115,053
Balance from 1887			132,793
Balance Dec. 31, 1888			$247,846

Operating expenses were 18⅛ per cent., against 22 in 1887. Gross earnings increased 18⅝ per cent., and net 23½ per cent. The directors have followed the same course as the Central company in encouraging the employés to invest their earnings, and the report says: "Your stations are for the most part under a tropical sun and in localities where habits and customs of life are of a demoralizing character. * * * The absence of misbehavior and of sickness at our stations is an evidence of the good results of this system of practical co-operation and economy." The increase of earnings is attributed to the growth of commerce and the better working of connecting lines which there is reason to believe will be maintained. The manufacture of the duplicate cable was completed Dec. 14, and it is expected that it will be laid early in February. It will be paid for from surplus earnings. The quarterly dividend, payable Jan. 12, 1889, is $35,860, and the above surplus of $247.846 is the balance above this payment. The company has 656 shares of its own stock and 1,362 of the Central & South American Company in its treasury.

The "Triumph" Automatic Gas Burner.

Those who are not fortunate enough to be within connecting distance of electric light circuits and must perforce employ gas, have nevertheless the opportunity offered them of making the use of the latter as little disagreeable as possible. The avoidance of the use of matches by means of electric gas burners has, therefore, seen considerable extension during the past few years, and "automatic burners," as they are called, requiring merely pressure upon a push button to light the gas, have become very popular.

Since the first successful attempt to construct an automatic burner, whereby gas could be lighted and extinguished by pressing buttons placed at a distance from the burner, notable improvements have been made from time to time. It was at first thought that two separate circuits were required, one to cause a movement of the gas-valve turning on the gas, the other to pass through an induction coil and so provide a spark for lighting. The discovery that placing in the circuit a spark-coil, consisting of copper wire with an iron core, in no way interfered with the action of the magnet operating the valve, and at the same time produced at the circuit breaker at the tip of

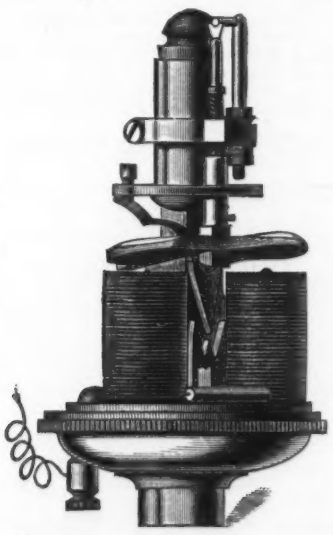


FIG. 1.—THE TRIUMPH ELECTRIC GAS LIGHTER.

the burner a spark sufficient to light the gas, so simplified the apparatus that its introduction has finally become general.

The Electric Gas Lighting Company, of Boston, one of the pioneers in this field, have in the past brought out several excellent styles of burners; one, the "single magnet" ratchet automatic No. 4, has been in large use for years. They have recently, however, produced the "Triumph" automatic burner No. 12, which will attract attention by its novel features, as illustrated in the two views, Figs. 1 and 2. In this burner a single electro-magnet, when the circuit is closed through it, attracts an armature of annealed Norway iron, which is normally held up by an adjustable spring. The armature projects into a slot in a vertical bar of rectangular shape, on which is pivoted a lever, the upper part of which engages with a V-shaped projection on the pillar. Two springs, extending from the base of the bar upward, keep the lever in its proper position. The cam, which oscillates the valve, has two V-shaped recesses, one slightly deeper than the other, in either of which the lower end of the lever, also V-shaped, engages.

Supposing the armature to be attracted and the lower end of the lever to enter the deeper recess, the cam is then thrown over, opening the gas-valve, and the bar carrying the lever, as it descends, engages a projection in the electrode-rod, and thereby breaks the circuit at the burner tip, causing a spark which lights the gas. The moment the armature is released and lifted by its spring, it raises the bar, and the electrode-rod again closes the circuit, which is alternately broken and closed as long as the current passes to the burner. If the circuit to the burner be broken at the press button, the armature rises to its normal position with the lever, which then engages the V-shaped projection in the pillar. The cam, in opening the valve, has swung past the centre, and its shallower

FIG. 2.—THE TRIUMPH ELECTRIC GAS LIGHTER.

recess is now directly under the lower end of the lever. By closing the circuit the armature is again attracted, but the lever, moved by it, cannot descend in this recess so far as to move the electrode-rod; consequently the circuit is not broken at the tip of the burner, while the cam is thrown in the opposite direction to that which opened the valve, therefore closing it and extinguishing the gas.

It will be seen that only one wire and a single press-button are required to light and extinguish this burner, and that only half as many wires as usually employed are required.

Fixtures that are wired for pendant burners may be supplied with the "Triumph" automatic by connecting in a press-button between the battery and burner.

American Engineers and the Paris Exposition.

Mr. R. W. Pope, secretary of the American Institute of Electrical Engineers, is in receipt of the subjoined communications from London, in regard to the Universal Exposition at Paris next year, one being from the Institution of Civil Engineers and the other from the Society of Arts. The first letter says:

It is reported that many Engineers from the United States will probably visit Europe during the International Exhibition which is to be held in Paris in 1889.

In view of this, the Council of the Institution of Civil Engineers, at the first meeting of the present session, directed an inquiry to be addressed to you, to ask, 1st, Whether this report is correct, and, if so, whether your Institute can give any idea of the number of your members likely to come. 2d, Whether they will travel by way of England; and, 3d, What may be expected to be the approximate date of their arrival and the duration of their stay in this country.

The object of this inquiry is to enable the council to consider the possibility of making such arrangements as may best tend to further the objects which the visitors have in view and to render their visit as useful and agreeable as possible.

The council need hardly assure you of its good will towards its professional brethren in the United States, and of its desire to embrace this opportunity of manifesting its friendly feeling to the utmost of its power.

Of course, in any case, the facilities afforded by this institution are always at the disposal of your members. Signed by George B. Bruce, President; William Pole, Hon. Secretary; James Forrest, Secretary.

The second says:

The council of this society have been given to understand that a visit of American engineers to this country during the spring or summer of next year is in contemplation. The council will be very glad if the Society of Arts can in any way facilitate the visit of your members to England or render their stay here more pleasaut. They will be glad to place the rooms of the Society at their disposal; and if their visit should coincide with the Society's Annual Conversazione in June, they will be very pleased to see as guests on that occasion such of your members as may be able to attend. Signed, Abercorn, Chairman of Council; H. Truman Wood, Secretary.

The Institute is now co-operating with the American Societies of Civil Engineers and Mechanical Engineers, who have been similarly honored, to make a combined trip. A large number of engineers have notified their intention of making the trip, and it is likely that a special steamer will be secured for the journey over, the return being made according to individual desire or convenience. The rate, first class, to England, for the round trip will be only $110. Mr. Pope proposes to lay the matter before the Institute members in a circular.

Fares to the Chicago Electric Light Convention.

In a previous issue we gave notice that through the efforts of Mr. Geo. F. Porter, Chairman of the Transportation Committee, N. E. L. A., one and one-third rates had been obtained for all delegates traveling to the coming Convention in Chicago, in the territory of the Trunk Line Association, for points east of Niagara Falls, Buffalo, N. Y., Salamanca, N. Y., Bellaire, O., Wheeling, W. Va., etc. It gives us pleasure to announce now that Mr. Porter has secured the same rates from the Central Traffic Association, whose territory covers all that portion of the United States lying west of Pittsburgh, Pa., Buffalo, N. Y., and Bellaire, Ohio, and north of the Ohio River and east of Chicago, Ill.

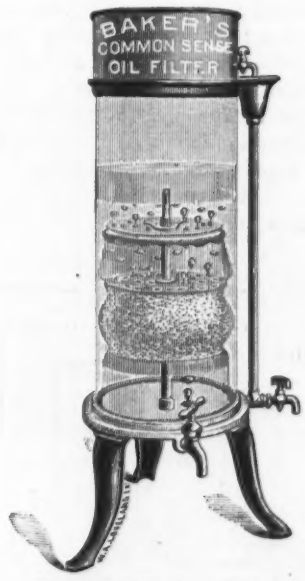
The method of obtaining the return ticket from the Chicago Convention (Feb. 19, 20 and 21) is extremely simple, as may be seen from a circular issued to all interested by Mr. A. V. Garratt, the Secretary of the Association. All who desire to join the Association should address the Secretary at the headquarters, 16 East Twenty-third street, as soon as possible. The meeting promises to be the largest and best ever held by the Association.

The Baker Common Sense Oil Filter.

Continuous lubrication for the engines and the dynamos of electric light stations is now recognized to be of the greatest importance, and in not a few such stations special and elaborate arrangements have been made for keeping a steady stream of oil on all bearings, using the same oil over and over again. Even where no special circulating system is employed, the oil which was allowed to go to waste after once using is now saved, filtered and used over again a number of times, thus avoiding a great deal of expense. An efficient oil filter is therefore a desirable adjunct to an electric light station.

To meet this demand Mr. Ch. F. Baker, of Minneapolis, Minn., has recently brought out the "Common Sense" oil filter illustrated in the accompanying engraving. As will be seen the filter is made of glass, so as to afford a means of noting its action at all times. The inside parts, holding the filtering material and cloths, are so fastened to a sleeve surrounding the central pipe that they can be lifted out and taken apart by any one in two or three minutes to clean or change the filtering material.

The action of the filter is very simple. The oil, admitted at the bottom, being lighter than water, naturally



THE BAKER OIL FILTER.

rises to the top, while the metallic particles and other impurities, heavier than water, go down; and in this condition it is easy to separate them when the drop form is broken by the capillary attraction of the wool, which is employed as a filtering material. The clear oil which gathers at the top of the water can be drawn off by the cock shown at the front, which connects with a pipe which passes up the centre of the filter.

The apparatus is employed in several electric light stations, and, we understand, with good satisfaction.

The Electrolysis of Common Salt.

Mr. N. N. Beketov, of Charkov, has recently communicated to one of the scientific societies of St. Petersburg the results of his experiments on the electrolysis of common salt. All the sodium products are at present obtained by the Leblanc or ammonia process, and several manufacturers have, it appears, applied to Mr. Beketov

for an opinion as to the comparative advantages of these processes. Being of the opinion that neither the Leblanc nor the ammonia process was as perfect as it ought to be, Mr. Beketov determined to try electrolysis, though he had already experimented unsuccessfully in this direction some years before. This last set of experiments have, it is stated, been more promising, though they have not yet been tried on a commercial scale. The inventor sends a current through a mass of fused salt, the temperature of which is about 500 degrees Centigrade. In this condition it is a fair conductor, and is rapidly decomposed by the current. With an electromotive force of 5 volts and a current of one ampère 36 pounds of salt can be completely decomposed in twenty-four hours. From this the author argues that considerable economy can be effected by the adoption of the new process.

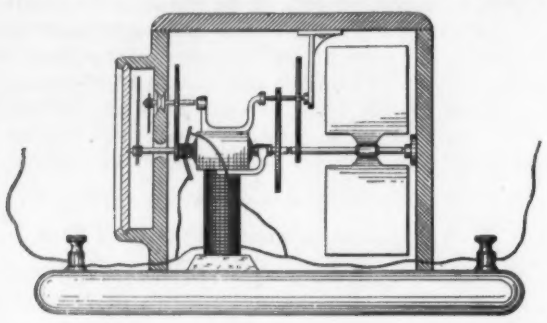
The Operation of Coal Mining Machines by Electricity.

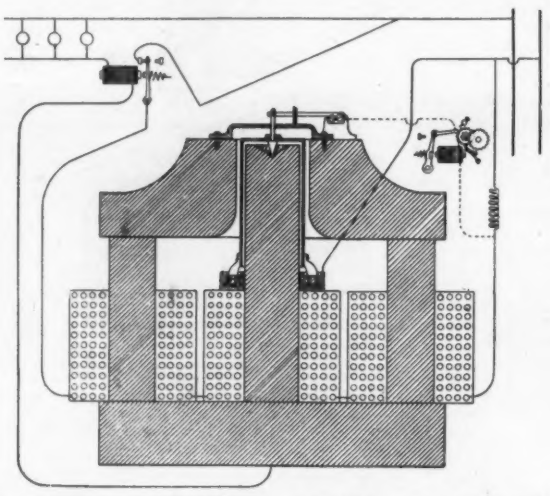
One of the newest and latest applications of electric power to mining work can be seen daily in operation at Mr. T. C. Heimes' "Drane Colliery," near Osceola, Clearfield County, Pennsylvania. Here a most interesting application of motors for mining work has been devised by Mr. F. M. Lechner for operating a coal-cutter by electricity. Mr. Lechner is well known as being not only the first inventor of coal-cutting machinery, but also the first to operate compressed air in mines for this purpose. His long practice and experience in the coal-mining field has made him familiar with all the difficulties attending the use of machinery in mining work, and ever since electric power has been in use for industrial purposes, he has made a study of the problems in adapting it to this work.

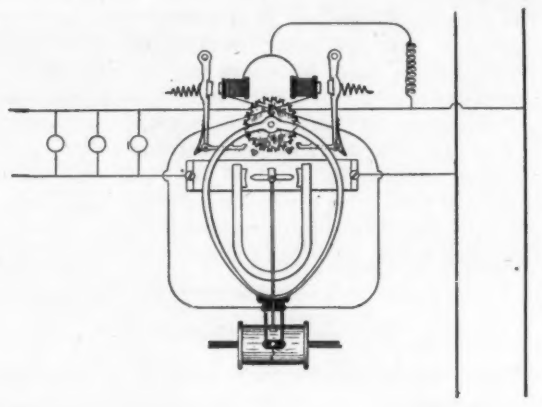
It soon became evident to Mr. Lechner that the best results could only be obtained by operating the motor and cutter apart, as otherwise the size and weight of the cutter with the motor mounted upon it would prevent its easy transportation to the mine. In order to do this the following arrangement has been adopted in the mine before mentioned, and has proved very successful: The motor, which is a 10 h. p. of the Sprague type, is mounted upon a truck, running upon rails, so that it can be very easily handled and hauled from one position to another as occasion requires. The entire weight of the motor is less than 1,000 pounds. The cutter operated by the motor, which in this case is the "New Lechner," is set in position in the room to be cleared, and is connected with the motor by a five-eighth inch rope belt, running in V-shaped grooved sheaves, one being on the motor and the other on the cutter. This connection is long enough to allow the motor to be operated 30 feet away from the cutter, and has been set in a position in this mine 1,600 feet away from the dynamo. The motor is held in position by guys at the point of use. By means of screw jacks that can be easily adjusted to any height with loose sheaves upon them, the cutter can be operated at any angle to the motor, and the connection is made taut by moving the truck upon which the motor rests and securing it in the right position by guys.

All mining engineers are familiar with the difficulty attending the working of the cutters in the limited space generally allotted them in mines, and how essential it is to have each machine divested of every pound of surplus weight. They also know what care must be exercised in moving it with great iron crow-bars, to prevent injury to the more delicate parts of the engines, and, however careful, how frequent it is that connecting rods and other parts are so impaired that the machine has to be sent to the shop; then how the rugged action of the engines shakes everything loose on the machine, however firmly they may appear to be adjusted. All this is avoided by the absence of the engines, the machine running as smoothly as a buzz-saw, and, as a consequence, cutting with the same facility. By this plan three machines can be operated by one motor, for when one room is cut, the motor can at once be hauled to another room where a machine is in readiness and position. It cuts that room and passes to a third while the coal is being removed from the first two and the cutters are being again placed in position.

It was found, upon a preliminary trial of this apparatus at the Osceola mines, that by its use two men are able to excavate 100 tons in ten hours, and that they can move the cutter as often as desired without any auxiliary aid. The efficiency of both dynamo and motor is said to be over 90 per cent., so that, allowing 10 per cent. drop on the line, nearly 73 per cent. of the power delivered to the dynamo pulley can be depended upon at the motor for work. It has been estimated that the cost of equipping a mine for the purposes of operating machinery with electricity is only about one-half the cost of equipping with compressed air, and the price of maintenance shows about the same proportion of saving.







FIGS. 1, 2 AND 3.—VARIOUS FORMS OF EDISON METERS.

Six Years' Practical Experience with the Edison Chemical Meter.*

BY W. J. JENKS.

"Measure for measure" has ever been the underlying principle of the trade of the world. The mess of pottage for which Esau bartered his birthright was as truly, in his eyes, a recompense for the distinction and the patrimony with which he parted as the property and the necessaries of life which we acquire are, in our view, an equivalent for the gold and silver which we pass from hand to hand in every-day exchange.

If we start out in life with the notion, so fondly cherished some time or other by every human heart, of getting something for nothing, we shall speedily realize the truth of what somebody has happily expressed in verse.

> The motto of the world is "give and take,"
> It gives you favors, out of sheer good will;
> But unless speedy recompense you make,
> You'll find yourself presented with its bill.

We are not in business matters long contented with any system of guess-work as to what the amount of this bill ought to be. Where values cannot be measured, we demand averages based upon long experience. Where it is possible to measure goods delivered, the ingenuity of man is untiring until some means is found adapted to the uses of all the traders of the world. It is only so far as we can draw from nature's limitless supply of necessaries and blessings "without money and without price" that we fail to find in these days a meter check upon our consumption. As long as people live in civilized communities, water and artificial light will represent somebody's labor, and as they come to be more and more generally used, they must be more and more accurately measured.

Perhaps it has never occurred to many of us that about all the system of measurement that has ever quite satisfied mankind is the method or device by which we reckon the passage of time, which does not cost us anything. We look with suspicion on the scales of the butcher, and we don't believe the milkman's quart is more than two-thirds as large as it was years ago, though the price has advanced several per cent. When we buy drygoods we speculate on whether it isn't best to redetermine the length of a pendulum that will beat seconds at the level of the sea, or establish a new yard on the metric basis, after we measure the distance from the equator to the poles again. We know by the ticking of the water meter that it is away off any standard, and last and oftenest we anathematize the gas meter and the man that reads it as being alike unsanctified.

Now the electric current meter is a baby yet, but it is very likely to be considered by the great majority of mankind as a direct descendant of the gas meter—"a chip of the old block." Unfortunately we cannot record directly the light or power really delivered from any source, and an approximation to such a record through the measurement of the quantity of energy supplied, is our only practical alternative. The method which we shall examine to-night, is thus far the only commercially successful means of measuring the energy delivered to electric lamps or motors. It is doubtless the first-born of a large family which will share in the stigma which the tribe of meters of all kinds have always borne. To show how far the stigma in this case is undeserved, and how much more accurately we can measure the mysterious intangible something, which we only know is a manifestation of energy and which we call electricity, than we can the palpable forms of matter which are apparent to all the senses, is the purpose of this paper.

In the approximation which we make to the measurement of the light, heat or power secured from gas, we have three variables: quality of gas, rate of flow, and form of burner or method of consumption. In electrical work we eliminate at once the first and one of the most uncertain of these variable factors, for there is no difference, so far as we can discover, in the quality or commercial value of electrical energy from different sources, unless we change the method or the rate of its delivery (as, for instance, send it out in intermittent or alternating impulses).

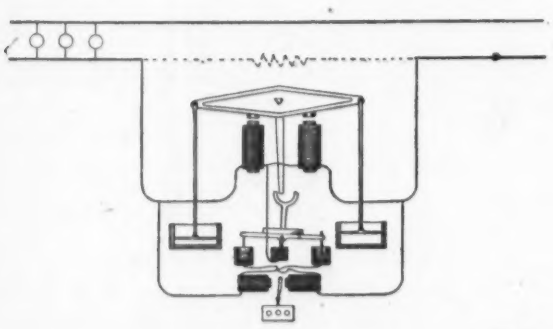
So in order to arrive at a price at which we may profitably sell light or power, we must know the electrical horse-power demanded by the translating device for a given result; that is, the efficiency of the lamp or motor and the energy actually delivered during the time of consumption. The work done or heat generated, which bears a definite relation (in a given type of lamp or motor) to the light or power produced, is expressed in three factors—pressure, current flow, and time, and the product of these, joules, or units of work accomplished in a given period, is what we desire to measure. In the Edison system the light of the lamp and the speed of the motor are based upon the supply at their terminals of a constant pressure, and as the Edison meter is in its relation to the resistance of the circuit practically at the lamp or the motor, it may for all commercial purposes be regarded as always acted upon by the constant standard of E. M. F. applied to the device which transforms the electricity to the useful energy of light or motion. Hence we really make this a joule meter, even while we omit the pressure, which is a constant, and make it a measurer of current and time, or a coulomb meter. Its construction is based upon the fact that a given ampère flow will deposit a given weight of metal per second, and so, knowing the weight of zinc deposited on a plate, it is easy to calculate the number of ampère seconds. In practice we take the hourly deposit (1,224 milligrammes of zinc by one ampère), and knowing the fraction of an ampère required for the standard lamp, we can readily arrive at the lamp hours for which the customer should be charged. It is now becoming common to charge so much for an ampère hour, and sometimes the price is the same, whether supplied to lamps or motors, which are thus often included within the registration of one meter.

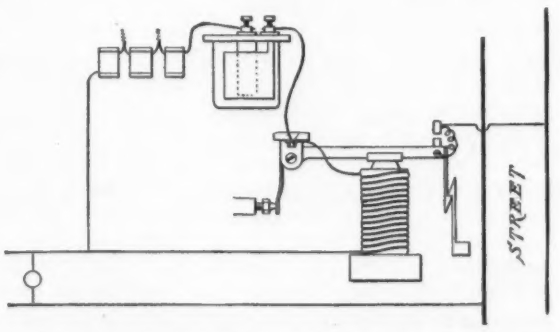
It is in a comprehensive system of house to house supply, where every unit of light or power is made separately controllable, that the necessity for such a meter appears most vital.

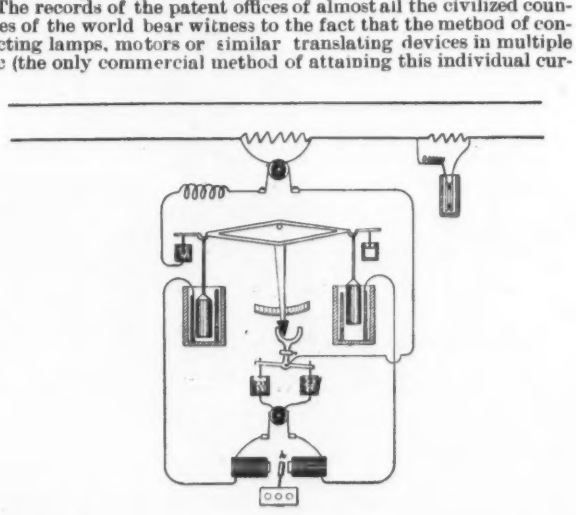
The records of the patent offices of almost all the civilized countries of the world bear witness to the fact that the method of connecting lamps, motors or similar translating devices in multiple arc (the only commercial method of attaining this individual current control of current actuated by safe potentials) was original with Mr. Edison. But beyond this, there is no question that we owe to him the first comprehensive conception of that form of multiple arc distribution which, by combining a low resistance armature, a feeder system of transmission, and a high resistance lamp and motor, has made it possible for us to secure at all lamps and motors a marvelously close approximation to uniformity of pressure, and the expenditure of the largest economical percentage of the initial pressure in overcoming the resistance of the carbon filament, or the motor armature, and thereby producing the greatest amount of useful work.

To Mr. Edison's view each detail of such a complete system appeared full of importance, and so we find him, almost before he had a commercial lamp, working on a meter by which each customer's consumption could be accurately determined, and which could be placed on his premises and inspected at such intervals as experience had shown was reasonable in the supply of the other measurable quantities, gas and water. He foresaw that it must not only be accurate, but cheap and durable. In his study of the subject he applied several principles of motion and registration, tried a great number of experiments with each, and secured several patents. Among them are the following:

Fundamental electric motor meter.—Patent 242,901. Application filed March 3, 1881. Figure 1 shows an old example of a large class of meter inventions in which some kind of an electric motor driven either by part or all of the current to be measured, is employed to overcome a fluid friction, but the







FIGS. 4, 5 AND 6.—VARIOUS FORMS OF EDISON METERS.

* A paper read before the American Institute of Electrical Engineers at the College of the City of New York, Dec. 18, 1888.

claims cover broadly the combination of a circuit, motor, fan, or other definite loading and registering apparatus.

Fig. 2 shows another form of electric motor meter. No. 370,123. Patent applied for April 17, 1883. The form of motor used is a development of "Sturgeon's wheel," the wheel being transformed into a cylinder surrounding one pole of the magnet, itself being surrounded by the other pole. In this meter the indefinite friction is reduced to a very small factor, brushes are replaced by mercury contacts, and a very compact and simple form is possible. Probably if mercury did not have such a chronic inability to behave itself in practical continuous work, and if it really possessed the ideal character of a liquid which it commonly gets credit for, we would have seen this meter put into practical use by some one of the many inventors who have given it attention. This patent covers, among other things, the placing of the inductive portion in the direct circuit and the fields in multiple arc therewith. A magnet in the main circuit closes the field circuit whenever the first lamp is attached, thus stopping the motor whenever the current flow is arrested.

Galvanometer recorder.—Patent 307,030. Application filed Oct. 10, 1883. Fig. 3. This covers broadly a multiple arc circuit, a

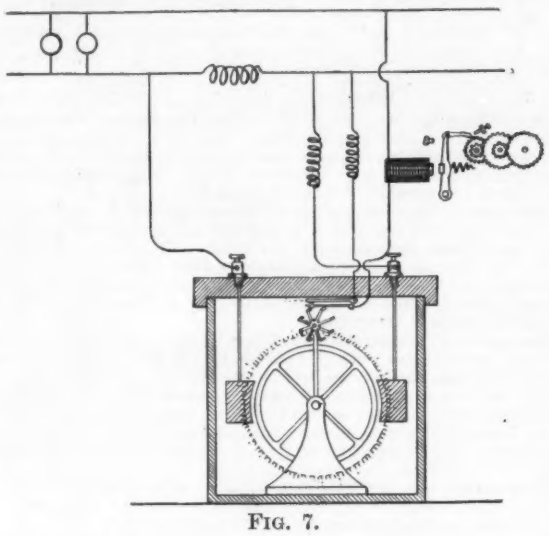


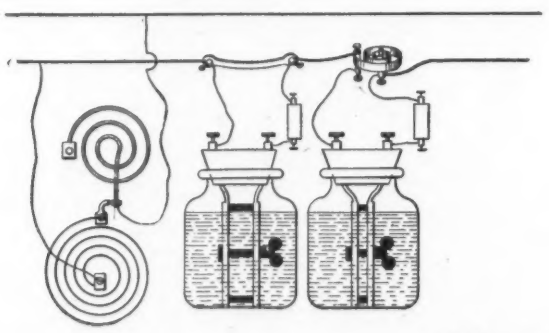
FIG. 7.

galvanometer in the main line, a circuit controlled by the needle, electrically operated apparatus in this circuit, and indicating or registering devices. Preference is given to a stylus recorder, the diagram made to be measured by a planimeter.

Recording electro mechanical meter.—No. 293,435. Applied for Aug. 14, 1882. Figure 4 shows a pivoted beam oscillated by electro-magnetic coils in the main or a shunt circuit, the rapidity of motion (regulated by air dash-pots of large surface) being practically proportional to the strength of the current. The recording mechanism is actuated by a local circuit operated by mercury contacts.

Fundamental electrolytic meter.—Patent No. 251,545. Application filed March 20, 1880. Fig. 5 shows the electrolytic meter according to the first Edison patent. An electro-magnetic cut-out is shown and claimed as part of the meter. The principal claim covers the use of an electrolytic cell placed in a shunt circuit, the resistances being so proportioned that a definite fraction of the current passes through the cell

Recording electrolytic meter.—No. 304,082. Application filed Aug. 14, 1882. At the time of the Paris Exposition of 1881 the Edison meter was exhibited in the form of an automatically recording apparatus, two electrolytic cells being used, one plate of each suspended from the beam of a sensitive balance, the circuits being so arranged that one cell only is in circuit at a time and the direction of current in that cell is such that the electrolytic action will throw the balance out of equilibrium, cause the beam to "kick," and by that action throw the current to the other cell and register "one" on the counter. Whether this form was seriously intended for general use may be doubted, but it was very carefully worked up, several different forms patented, and it attracted a great deal of attention and well-deserved admiration in its time. Figure 6 shows plainly the general form



and the connections. The counter is operated electrically by the motion of the index of the balance; it contains a mercury cup, dash-pot and two reversing commutators, operated by hand once a month to keep the transfer of copper from plate to plate from going always in one direction; a simple electrolytic cell is used as a check. This is probably significant of the inventor's lack of faith in mechanical meters, and is particularly interesting to look back upon, in the light of subsequent progress.

Revolving recording electrolytic meter.—(Still pending in the Patent Office.) Figure 7 shows an interesting modification of an integrating electrolytic meter, in which between two electrodes immersed in the electrolyte is placed a wheel or cylinder of the same metal, free to revolve on its axis. It is apparent that if the wheel were perfectly balanced and delicately poised, the passage of a current would alter the balance, and it would revolve at a speed depending almost entirely on the friction of its bearings. But if it were first caused to revolve at a definite rate for one-half a revolution, the lower limb moving in the same direction as the current, there would be a deposit and loss on opposite halves of the disc, causing a variation of position of the centre of gravity around the point of support, causing the revolution to continue at the same rate for the same current or at a rate proportional to the current.

The diagram shows a dial scale for reading fractions of a turn and an electric counter recording complete revolutions.

Floating electrolytic cell.—Patent 248,565. Application filed Dec. 15, 1880. Fig. 8 shows a udiometer intended to decompose water, collect the mixed gases in a bell-glass, and when a definite quantity is evolved by the raising of the glass automatically cause recomposition (and consequent falling of the glass) by closing a circuit through a platinum coil which becomes heated thereby. This operation is to be repeated continuously while the current is passing, a counter giving a record of the number of charges of gas exploded.

Among the difficulties of using such an apparatus are the comparatively high E. M. F. required, the energy wasted, and possibly, like the nitro-glycerine engine, "the necessity of providing a new machine after each explosion." A very similar apparatus has been recently proposed as a laboratory standard for current measurement.

Automatic temperature regulator.—No. 251,558. Filed August 30, 1881. This patent, illustrated in Fig. 9, covers important features of the Edison meter of to-day. Briefly, these are: (1) the resistance acting as a source of heat to prevent freezing of the liquid in the bottles; (2) the thermostat completing the circuit at the proper degree of temperature; (3) distance pieces for holding electrodes a fixed distance apart.

Fundamental temperature regulation.—Patent No. 265,774. Application filed Nov. 11, 1881. Fig. 10 illustrates a method of generating heat by the action of a thermostat energizing an electro-magnet controlling a valve, which being opened permits water to flow upon quick lime. This is one of the methods illustrative of the broad idea of "causing a fall in the temperature to set in action agencies for generating heat," and thus maintaining automatic temperature regulation in an electrolytic cell. Another method here described is the one now practiced, the closing of "a circuit to an electric lamp placed in proximity to the cell." On the same date of this application Mr. Edison filed Patent No. 281,352, describing one of the most vital features of the practical apparatus, namely, amalgamated zinc electrodes in a solution of sulphate of zinc. This overcame the disadvantages of copper plates, which had formerly discouraged the inventor.

Compensating coils in electrolytic meters.—No. 251,557. Applied for May 27, 1881. Fig. 11 illustrates certain minor claims of details, some of which apply to the Edison meter of to-day, and one feature without which probably no electrolytic meter would be practical, the "compensating spool" having a + temperature coefficient to balance the — coefficient of the bottle-resistance. This patent also covers the use of two cells, depositing with unequal rapidity.

The original plan involves, of course, only a two-wire meter. This was first made with a seperate resistance for each bottle, one of them being intended to register a month's consumption, the other three months. It was also proposed that the two compartments have separate keys, the inspector of the three months bottle thus having a private check on the three readings taken in the same time from the other side. It was soon found preferable to weigh both sets of plates together, particularly as inexperience in the manipulation gave rise to errors against which the duplicate records formed a check of great usefulness. This duplication has been found unnecessary in the smaller sizes.

The student of the meter question may find interesting modifications of these general principles in patents 240,678, 281,352 and others.

It has been argued that the Edison chemical meter, in its best estate, is open to several very serious objections:

1. The necessity of the expense attending the removal and replacement of the bottles, usually at monthly intervals, and the complete disconnecting and weighing of their plates. So far from being a detriment, this is seen to be in the light of practice a positive advantage. A gas meter is adjusted once for all, and once placed is inspected only at long intervals, or when strongly suspected of inaccuracy, while the Edison meter receives thorough inspection and radical readjustment every month. The sources of error lie almost entirely within the bottle, and are thus speedily corrected.

2. The necessity of employing what objectors are pleased to term a "chemist" as a meter man. In the early history of any art, until the conditions of practice become thumb rules, the manipulator of an important device should be a man of intelligence and some originality of ideas. After a time the work becomes simply a matter of routine, and the occasional oversight of the manager or other official will detect any irregularities. Thus it has been with this branch of our work. The most of our meter men are young, and receive only moderate pay, as the statement of cost of operation, elsewhere given, conclusively shows. Accuracy and caretaking in matters of detail are the prime requirements. The work has been greatly simplified by arrangements with Mr. Edison, by which electrolytic zinc plates, standard zinc sulphate solution in carboys (or salt, if preferred), distilled mercury and four simple reagents, for the testing of water for solution by such companies as prefer to prepare it themselves, as a matter of convenience or economy. These reagents are:

(1) Ammonia water.
(2) Ammonia sulphide.
(3) Nitrate of silver, and
(4) Sulpho-cyanide of potash,

a few drops or a small crystal of each, as the case may be, to be added to separate portions of water. Any meter man can thus make the four simple tests, which, by a precipitate or by cloudy coloration, will show the water to be unfit for use.

Ordinarily, ice water is available, and where this fails, a simple apparatus for condensing and distilling, costing $25, is sometimes desirable.

Sources of Error.—This brings us to the consideration of the real importance of the sources of error. Nothing that man has made is free from some of these drawbacks to accuracy, but when we except those mechanical imperfections common to all electro-mechanical devices, it is surprising how few appear which play any important part in the result, and how far these few are neutralized. In order to point the application of the few facts and diagrams to be shown, let us refer briefly to the criticisms made on this much-misrepresented but important friend of the Edison manager.

From the English *Electrician* of Dec. 16, 1887:

"Edison calculates the total consumption of current by passing a known (or supposed known) fraction of the total current through the meter, and the energy supplied is calculated on the assumption that the difference of potential is constant throughout the circuit. This assumption is, of course, only approximately correct."

From the same journal, Dec. 30, 1887:

"In the third edition of Sir David Salomons' work on the 'Management of Accumulators,' the author (on page 105), gives the following definition of Edison's meter: 'A thing of the past, depending upon the deposit of some metal.' We are, unfortunately, a little doubtful as to the immediate accuracy of the first part of this description, inasmuch as we are under the impression that this apparatus is still extensively employed by the Edison Company of the United States; but in the light of the statements alluded to above, there can be but little doubt that Sir David's description will, sooner or later, be perfectly accurate. As to the 'deposit of some metal,' which appears at present somewhat erratic, we suppose the balance is made up on the settlement of the account. But if these accounts have any foundation, it is perfectly clear that the error is entirely against the company. As we recently had occasion to remark in our articles on the Brighton installation, the Edison plan, by which a fraction only of the current supplied is measured, can be accepted as little better than a makeshift at the best."

One more quotation (from THE ELECTRICAL WORLD of a little more than a year ago, Oct. 22, 1887), of some remarks made at one of the meetings of this Institute. It is especially desirable to bear them in mind, as an illustration of the idea that a little

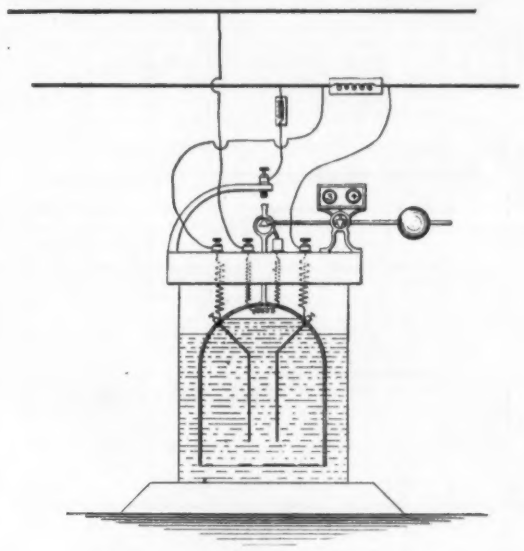
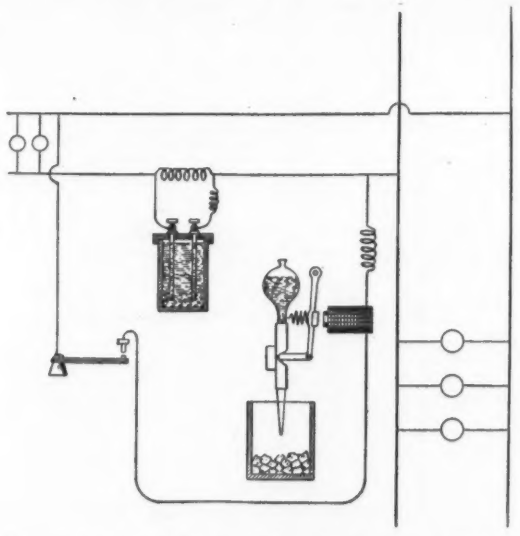


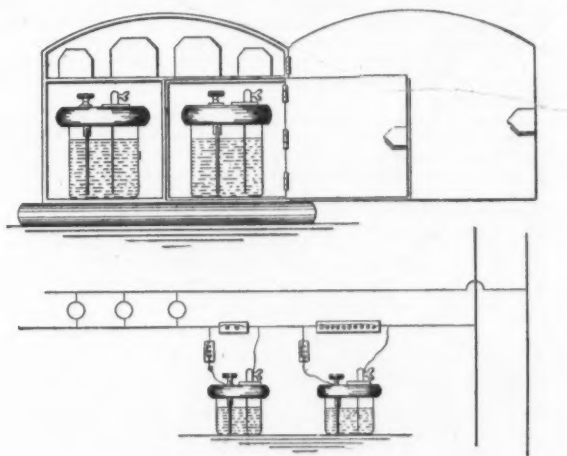
FIG. 8.

knowledge and a great deal of theory on any subject is a dangerous thing in the light of actual experience:

"There has been already a great deal of time and a large amount of money spent on electric meters for direct currents, and I do not think we have had any current meters of any value whatever.

"The electro-chemical system, in use by a very prominent company here, was put out with a great deal of confidence with the results to be obtained from it. I think any one looking at the principles involved would condemn it from the start. You are to take a small fraction of the total current, and a very small fraction indeed, and pass it through an electrolytic cell, the character of which varies from time to time, so that the resistance is never fixed, and pass the bulk of the current around a resistance which is practically fixed. The change in the resistance of the metal would be but a small proportion of the change in the resistance of the electrolyte. Now in such an instance as that you are measuring a very small fraction of the current passing, and whatever error you have you are multiplying that error by the fraction. If you are measuring $\frac{1}{1000}$ you are multiplying your error by 1,000. Any one who has had much to do with electro-metallurgy knows that the cells are constantly changing;





FIGS. 9, 10 AND 11.—VARIOUS FORMS OF EDISON METERS.

that to keep the deposit regular and uniform, to keep the resistance of the solution uniform, they must be constantly attended to. There is not an electro-plater in the country who does not once in a while go in and stir up his baths. Such an instrument is of no real value. We may, therefore, dismiss those instruments entirely from consideration, I think.

"If any one will take the record of the patent office on electric meters, he will see that there has been no small amount of time and thought and money spent on that question. Practically, we are in the same position we were before. We had nothing except the electro-chemical meter, which as I say, I consider entirely worthless."

The lack of information on this subject, thus illustrated, will be seen more clearly by an analysis of the possible value of the sources of error.

In the hands of an inexperienced person almost any method or device, good and reliable itself, may be misapplied so as to gain an unenviable reputation. An Edison meter cell may be so manipulated as to measure almost any resistance and vary between wide limits. A few practical rules have, however, been applied, and the bugbear which has so disturbed the visions of those who have looked at the matter from a theoretical standpoint only has disappeared. In other words, we are able to reduce practically to nothing this error, and it therefore appears in the results only as a slightly disturbing element at the lower end of the deposit curve, and always against the company.

The German silver shunt.—The extract I have read specifies quite distinctly the slight error introduced by the change of resistance of the German silver shunt with temperature variations For each 25 degrees Centigrade, or 45 degrees Fahrenheit, this variation is but 1 per cent. Within a range of 40 degrees it is 0.0249 per cent. for each degree (Fahrenheit). A shunt having 0.01 ohm. at 60 degrees Fahrenheit would be at -2 degrees Fahrenheit 0.00984, and at 100 degrees Fahrenheit 0.01009 ohms. The maximum error which can ever occur is about 2 per cent., due to a change from freezing to 120 degrees Fahrenheit, the maximum reached in any of the meters at full load. As a matter of

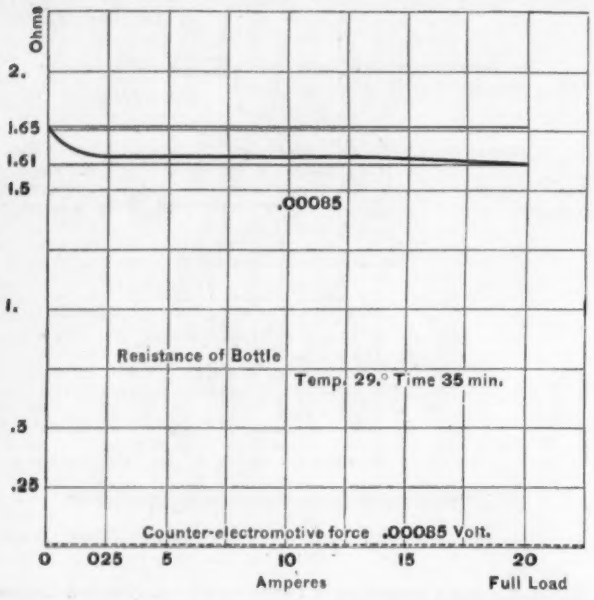
practice, meters are so placed as to vary not over 30 or 40 degrees, on the average, either from atmospheric changes or the heating of the current.

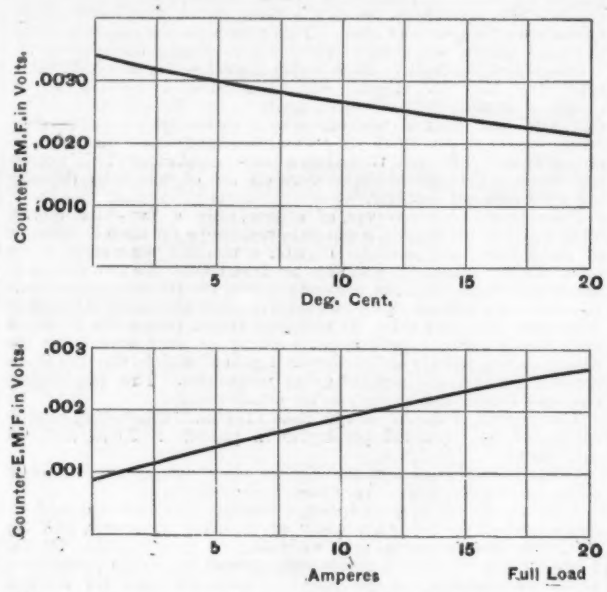
Counter electromotive force.—Fig. 12. It is plain that the change due to a rise of current in the meter here illustrated, from 0 to full load or 20 ampères, is 0.0017 volt. As this counter E. M. F. appears in practice as a factor of resistance, its effect is shown in the current resistance curve.

It is also clear that the error due to the rise in temperature from 0 deg. to 20 deg. Centigrade is 0.0012 volt. This is one of the factors in the temperature resistance curve, Fig. 13.

Bottle resistance and current.—The two errors, increase of counter E.M.F. and consequent drop in volts, and decrease of absolute resistance and consequent rise in volts, jointly resulting from an increase of ampères, about balance each other, forming a beautiful compensation which makes this curve almost a straight line. Fig. 14.

Temperature compensation.—Fig. 15. Considering the bottle resistance by itself, the fall in counter E. M. F. and consequent rise in volts with a rise in temperature, adds slightly to the rise in volts attending the fall in resistance. These two factors are together opposed by the influence of the spool, whose copper wire increases so as to make a perfect compensation at 10 and 30 degrees Centigrade, with a slight bend in the curve at intermediate points.





FIGS. 12, 13 AND 14.—EXPERIMENTS WITH THE EDISON CHEMICAL METER.

Rate of deposit and current.—Fig. 16. This curve, the result of the combination of the sources of error shown by the others in detail, is so close an approximation to an absolutely straight line that it is difficult to detect any material departure excepting the slight bend at the minimum load. Into the depth and sharpness of this bend the element of time enters, but after passing this point the curve runs almost absolutely straight to a maximum load.

It is especially noticeable that the curve begins at absolute zero, while with Mr. Edison's early meter of the electric motor type, and others that have followed this principle, the theoretical curve is as shown by the dotted line. No curves deduced as are the above from long practical work have ever, so far as we can learn, been formulated of the performance of any other meter.

It is proper to say in this connection that the percentage of error from these causes is practically constant for all sizes of the Edison meter.

These sketches and the patents enumerated convey a faint idea of the months of patient analysis, the multitude of experiments and the scores of models and drawings which may be found described in Mr. Edison's note books, many a page written by his own hand, years before the electrical fraternity conceived of the importance of these devices for which the world now loudly calls. The electrolytic principle was finally determined upon, the details perfected, and more than six years ago the first devices were placed in the offices and stores of the first customers of the Pearl street station in this city, the first station in the world to distribute current for incandescent lamps by a comprehensive system of conductors buried underground like gas pipes. The experiments thus made were so exhaustive and thorough in their character, that the meter then designed is substantially the one in use to-day in numerous stations throughout the United States and several stations in foreign countries. The Edison Company has tested every form of direct current meter thus far found in any degree practicable without discussing (as vital) the question of economy either in first cost or operation, and has no knowledge of any other form which has been found to be as accurate under all working conditions, and as reliable when submitted to that tribunal before which so many carefully constructed electrical devices fail—the test of time. The Edison meter is also cheap, but this is of less vital importance. Hence all other forms appear to be commercially impracticable. Some have inherent defects, caused by variations of permanent magnetism. Some are too large to be of any value for commercial use, and they are almost, without exception, too costly and delicate for practical service, or too wasteful of the energy they demand for their operation. We have abundant evidence of the justice of these statements when we remember that out of the large number thus proposed, there is not another which has come into anything like extended use. The record which we can quote is therefore the only one from which any conclusions can be drawn as to future practice in this direction.

We shall be better prepared to appreciate the results obtained after glancing at the distinctive features of the meter as at present constructed.

Each consumer has a meter upon his own premises, and his bill is made out and payment required upon what the meter shows. To measure the current by means of a meter, and to do so with sufficient exactness to support a bill, the payment of which was to be insisted upon, at first seemed to many of the customers of our various companies an impossibility, and they accordingly resorted to various devices for the purpose of themselves testing the accuracy of the measurements. The most noteworthy of these, for the reason that it affords a simple and effective check, was to keep a record of the hours each lamp was in use, and by multiplying this number by the given rate of a sixteen-candle lamp per hour, to determine what the amount of the bill ought to be. There have been many instances where, in order to satisfy customers that the meters were reliable, we have taken their record at the end of a given time, during which the customer has kept an account of his lamp hours, and have presented bills upon what the meter showed, that the customer might check the amount of his bill by this simple rule.

Some months ago a very careful test, covering five months, was made by the Edison engineering department. Six Edison meters were connected in series with the meter of the Edison Electric Illuminating Company from the station by which the current is supplied to the offices occupied by the parent company. At the close of this test it was found that all of these meters registered within 1½ per cent. of each other.

An elaborate test was conducted at New Brunswick, N. J., by Mr. W. S. Howell, with seven meters put in series with ten lamps. The readings showed a variation of 1½ cents in the amount of the bill charged, while four of them were alike to a cent. The advantage of such accuracy is manifest not only to the Illuminating Company, but must also be satisfactory to the most exacting customer. One of our most experienced and successful managers testifies that in the use of about two hundred meters he found the poorest record to be very close, and sums up his experience by declaring that "without the meter they would be swamped."

Such abuses of the contract system as are shown by these expressions are so manifest to many contract stations from which we have asked for no letters, that some of them are already changing to a meter basis, and it is evidently only a matter of a short time when others will be compelled to.

At every meeting of the Association of Edison Illuminating Companies there has been a full and impartial discussion of the relative merits of the two methods. The result may be briefly and forcibly summed up in the following, unanimously passed at the meeting of the association held at Chicago, Ill., Feb 8, 1888:

"*Resolved*, That after a full discussion of the relative merits of the meter and contract systems in the numerous meetings of this Association, that it is the sense of the Association that the Edison meter is accurate, that the system is not too expensive for stations above 1,000 lights, and that the best financial results are invariably secured in a station selling by meter."

Fig. 17 shows the iron case of the form of meter placed at the time of starting the First District Station, September 4, 1882. The division in the G. S. shunt resistance for the long and short period bottles have given place to a method of connecting both to the same terminals. The flexible connections have been superseded by the spring clips, and in the three-wire meters two shunt resistances are placed as in Fig. 18.

Stripped of all complications, the connections of these types are clearly shown in the annexed diagram, Fig. 19.

The meter case is made of well-seasoned hard wood specially prepared to expel air and prevent warping, and to maintain high insulation; the door of heavy sheet iron properly lettered and numbered. This is held closed by a metallic button turning upon a small post, both passing through a vertical opening. The wire of a lead seal is passed through the button.

The conductors enter and leave the meters through holes in the side or bottom about two or three inches apart.

The thermostat is required for all meters situated in locations where the solution is likely to freeze. It is furnished as an extra attachment, and may be inserted in any size meter, and to it is attached a small contact point connected with a lamp socket. Into this socket is screwed a lamp, and when the temperature in the meter falls below a certain point, it will cause the thermo strip to curve up, bringing the two contact points together, closing a circuit through the lamp and heating the interior space. As the temperature returns to normal the strip straightens and the lamp is cut out. The adjusting screw in one complete revolution changes the elevation of the contact point $\frac{1}{16}$th of an inch, and being made with a six-sided head (numbered), $\frac{1}{6}$th of a turn will change the absolute temperature standard of contact about two degrees Fahrenheit. Thus the adjustment may be made sufficiently close.

The cells are partially filled with a 10 per cent. zinc sulphate solution, no special effort being made to render them air-tight, but to prevent evaporation. In these the zinc plates are supported by ebonite distance pieces, screws and nuts, and connected by copper rods with spring clips fixed in the top of the space.

The resistance in the main circuit is of german silver of the quality used by Elliott in his bridges, and so proportioned as to allow $\frac{1}{15}$th of the current to pass through the cell and its compensating spool.

The small portion of current passing through the bottle removes from one plate, and deposits upon the other the metallic zinc, which, when its weight is ascertained, determines the current transmitted.

The two-wire meters, authorized to be used with the three-wire system, are of two sizes only, five and ten ampères capacity, respectively. Anything larger than five ampères may be preferably divided to balance the two sides, and hence they are made of five ampères each side, capacity 20 of the present 16 c. p. lamps; 10 ampères, 40 lamps; 20 ampères, 80 lamps; 40 ampères, 160 lamps; 80 ampères, 320 lamps.

This will be made more clear by a

TABLE OF SIZE AND CAPACITY OF METERS.

Meter No.	Maximum ampère capacity.	
0	5	2-wire meter for 5 ampères.
½	10	" " " 10 "
1	10	3-wire meter for 5 amp. on each side.
2	20	" " " 10 " "
4	40	" " " 20 " "
8	80	" " " 40 " "
16	160	" " " 80 " "

In selecting the proper size of meters for certain customers it is borne in mind that a meter plate has, like a storage battery, a somewhat definite maximum capacity in ampère hours per month. The standard found most desirable is 150 milligrammes deposit per month per ampère of nominal capacity.

The normal capability is therefore understood to be restricted to an average work of one or two hours per day at this maximum load, which corresponds with practical work. If steady work is to be done for an average of three to four hours daily, the load should be about 20 per cent. less; if from five to six hours, about 25 per cent. farther reduction should be made to determine the proper limit for a given plate.

The meter is in practice placed in all sorts of positions. The general instructions simply provide that it should be kept clean and dry, inside the service fusible cut-out and easy of access.

The initial preparation of plates consists simply in thorough cleaning, covering the top and about an inch of the rod with a coat of asphalt varnish, amalgamating and drying (three coats when new) weighing and tagging of the positive plate, and placing in the solution.

When removed, the plate is re-weighed, and where two bottles are used their weights are compared by the meter man and his record sent to the book-keeper or superintendent.

The loss in milligrammes sustained by the positive plates is then multiplied by the meter constant, which gives the bill in dollars and cents. This constant is found as follows:

Let $ = price of one standard lamp per hour.
C = ampère capacity of standard lamp.

Then current through the bottle $= \frac{C}{975}$.

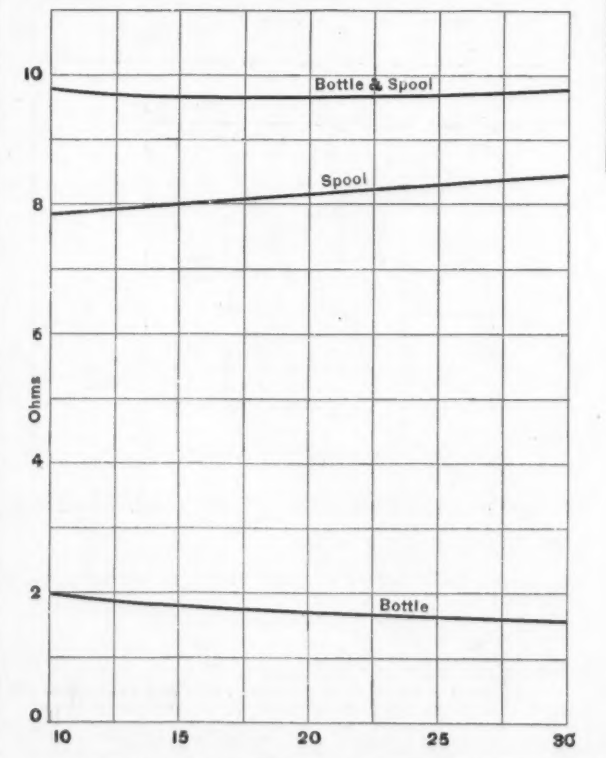
As 1,224 milligrammes (of zinc) is represented by one ampère hour, one standard lamp is equivalent to $\frac{1.244\ C}{975}$ milligrammes, at the price, $. Hence the price for current which has removed one milligramme of zinc will be,

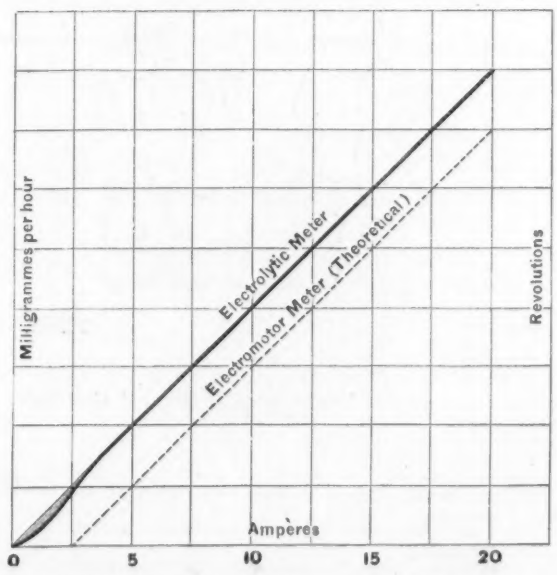
$$\frac{\$}{\frac{1.224\ C}{975}} = \frac{\$ \times 975}{1{,}224\ C} = Constant.$$

Recent improvements.—Nearly a year ago a series of exhaustive tests was undertaken at the laboratory of Mr. Edison to determine whether, in the light of years of experience since the initial experiments upon which the first methods were based, advantageous changes can be made.

The first result of these tests was the perfection of the three-wire meter, then being offered to the Edison stations. The present form of connecting spring clip was at once introduced. A diagonal arrangement of terminals, making it easy to connect from either side or from below, followed after. Then the production of pure chemicals by the Edison Laboratory, and the elimination of the error due to oxidation, already referred to, by proper treatment of the solution.

At a meeting of the Standardizing Bureau, held Dec. 17, 1888, it was voted to authorize the discontinuance of the two largest sizes of plates (40 and 80 ampères), and use in their places the 20-ampère plate with a proper change in the compensating spool in





FIGS. 15 AND 16.—EXPERIMENTS WITH THE EDISON CHEMICAL METER.

these important changes, which it will be observed simply follow as a natural result of the confidence established by experience, will probably be supplemented by others, none of which will, however, modify any essential features of practice, but simply apply processes which add nothing to the expense but tend to eliminate the already small sources of error. Among those indicated as likely to be recommended are a reduction in the size and change in the form of the bottles and method of closing; a each case. It was found perfectly feasible to measure the shunt resistances and weigh the plates more accurately than heretofore, thereby effecting a substantial saving in the cost and care of large plates. As an illustration, a 200-light plate only needs to be weighed to one-sixteenth of the exactness in units of what is necessary in a 12-light plate to secure the same percentage of accuracy.

It was also decided to authorize the use of one bottle in place of two for the three smaller capacities, which, as appears by the average figures given, constitute a large majority of the total number in use. This will probably be followed by a change in all sizes as soon as confidence in the feasibility of this plan becomes general. One-bottle meters for two-wire uses, and two-bottle meters for three-wire uses, will therefore be immediately produced.

slight change in the specific gravity of the solution, and a modification of the treatment of the plates by which the active surfaces shall be limited to those placed directly opposite each other in the cell.

These minor changes will aid still farther toward the result which Mr. A. E. Kennelly (under whose personal supervision the present tests are being made) predicted in a recent lecture would be realized, namely: that "The Edison electrolytic meter will in the future be recognized as the simplest and most accurate apparatus of its kind in commercial use."

An interesting application of this Edison meter principle has been made in England, and is described as follows in the *Electrician* article already quoted, relative to a multiple series installation at Brighton:

"The objections to the electrolytic method are absent, when it is employed in connection with a constant current distribution. In the first place we have now to measure the 'volt hours' across the terminals of the house connections, so that the meter is a shunt to the whole installation. By placing a high resistance in circuit with the meter in order to reduce the current in the shunt circuit, no error is introduced. Secondly, by integrating the E. M. F., and assuming constant current, we are introducing no non-existent factor; in fact, the current at Brighton is actually maintained constant within one per cent."

This suggests interesting possibilities in measurement of energy supplied to customers of series circuit systems.

But the only real criterion is that of practical success.

In order to discover what the practical men in the business think of the meter, a circular was recently addressed to the 26 stations in the country now operating the meter system, asking for their experience and opinions. To this we have up to this time received 22 replies. That you may judge of the convictions which they express, I will read the more important queries, and summarize the answers.

Have you used meters from the starting of your station?

Answers—Yes, 17; No, 5.

From your experience, what reasons would you quote for a change from the contract to the meter system?

All replies to this question indicate the unanimity of the opinion that the meter is far preferable. Some of the expressions are as follows:

(1) "There is no argument about lamp breakage. It is square dealing on both sides."

(2) "They are always superior, even to the best contract."

(3) "Less unnecessary burning; income in more fixed ratio to expenses. Customers are able to regulate their light bills. An accurate basis instead of guess work, to estimate schedule price. Life of lamps should be much longer by use of meter, by the stopping of unnecessary burning."

(4) "We should take in a great deal more money than we do now."

(5) "There are a few exceptional cases where we are getting a little more out of contracts than we would from a meter, but as we run by night only, this difference is made possible. I refer to early closing stores. If we ran by day these would use light by day on contract, while they would rarely do so if the current were measured. I find generally that dwellings on contract are constantly fully illuminated, but the day a meter is put in they find one lamp generally suffices. I believe our income would be slightly larger if everything were on contract, but our expenses would be out of all proportion. Immediately after taking charge of this station I looked up the last ten-minute record made by outgoing current, dated December 23 and 24. It is possibly a little unfair to take a day or night so near Christmas, as more light is used at that time than at any other. The nearest aggregate I could get out of 75 tests in money value was, at one cent per hour per ten candle lamp (and the company charged at that time 1¼ cents per hour), and after deducting station and street lighting, $2,868.90, while the income of the company for that month from all sources was about $1,100. Of course during the winter months the contract consumer gets more than he pays for, and is reckless in the summer, because he thinks he gets less than he pays for."

(6) "By all means were I to build and manage a new station I would start it on a meter basis, and carry it as far as possible."

(7) "Our object was to decrease the unpaid consumption and increase the revenue."

(8) "We believe, from our experience, we can supply more on

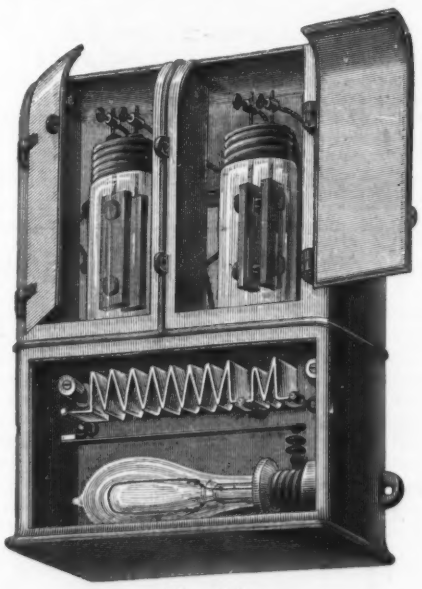


FIG. 17.

meters with the same power and get a better return from current used."

(9) "The contract gives a regular income to the company throughout the year, nevertheless in a majority of cases it is a system of robbery; electricity should be sold like merchandise—by measurement."

(10) "The principal reason for a change to a meter system was the impossibility of making contracts which were fair to the company. Customers will burn more light than they contract for, and though under a contract system it may be easier to collect bills, at the same time the income per lamp hour will not average much more than half that of the meter system."

(11) "It prevents people from consuming an excess of current, thus unnecessarily overloading the station."

(12) "Under a contract consumers abuse the use of the light, which abuse while doing the customer no benefit (the light not being necessarily used), increases the cost of operating and lamp breakage to the company very largely. In other words, you cannot trust customers to cut their own cloth."

(13) "More satisfactory to the consumer if he is economical."

(14) "Maximum revenue for maximum power."

(15) "Consumers can gauge the quantity of light for which they pay, to suit the business requirements."

Do you keep meters on contract installations for your own information? Some of the replies are as follows:

"We have, and find a contract customer is using about double what he pays for. Some customers have left us on this account, but almost always return."

"Yes; on all motors also."

"We run them in this way at intervals, for our own satisfaction."

One of the largest of the stations keeps a meter on each contract motor.

Have you evidence of any serious error aside from accidents? If so, please state explicitly what it is.

Eight stations, embracing the large ones at New Orleans, Rochester, La Crosse, Cincinnati and New York, reply to this question—"No."

One of the most experienced station managers makes this reply:

"We have none. In my judgment the greatest amount of complaints come from places where a notable lack of care is shown in properly preparing plates, weighing and handling; also where leaks and grounds are most numerous. The meter has in past years located many faults for me."

Is the feeling of your customers generally one of confidence in the accuracy of the Edison meter?

Most of the stations reply without other remark than emphatically "Yes." Some of the answers are worthy of being quoted literally.

"In some cases our customers keep count of the hours. All such customers say the meters are correct."

"Remarkably few objections by consumers to the results obtained."

"The general feeling is one of confidence."

"The confidence is fully as great as in gas meters; we have no difficulties on this account."

"Comp aints are very few from consumers."

"The meter to our customers is a blank. While we can persuade

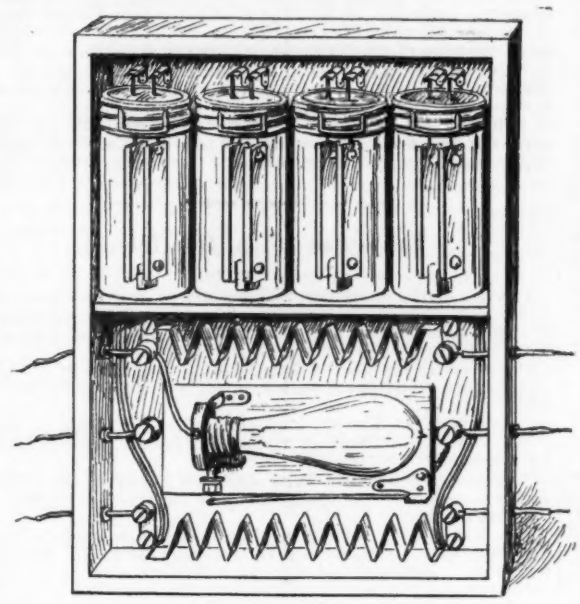


FIG. 18.

them that the meter is correct if properly manipulated, it becomes a matter of confidence in the meter man."

"One month ago one of my customers began keeping a record of the hours his lamps were burning. When his bill was presented it was four cents in his favor; so it is with a great many. The meter has given us good results."

"This question is rather a difficult one to answer. I have no doubt that the majority of our customers, if they were asked the question, would say that they did not believe in a meter. This is not due in a great many cases to any inaccuracy they have ever discovered, but merely to the general idea that meters are not worth anything, judged by the gas and water meter standards. We have had a number of customers test our meters, and in addition to this have given us strong letters of recommendation, and I have never seen the test where we had to recede from our position that the meter was correct."

"They have as much confidence in the Edison meter as in the gas meter, and probably a little more."

"Those consumers who keep a careful lamp account for a few months have faith in the meter."

From the results of your experience with the meter system, do you feel that you can indorse our recommendations to new companies that they adopt it as the most satisfactory method of serving the public?

"Yes. I have already advised several new companies to adopt it. Contracts are bad. They soon get the best of you."

"We believe that it is the only way to sell light. We only have contracts to satisfy certain customers."

"Yes, where practicable, which, however, is not always the case in starting stations in small towns."

"I do not believe in the contract basis at all. I feel that the meter is a good thing, and particularly because my Jew customers, and other economical consumers, never raise any questions, and we never have any trouble with them."

"Yes, most decidedly for large stations. The desirability of putting in a meter system depends on the size of the plant. I do not consider that any plant of over 500 lights can afford to get along without it."

"Yes, but would offer contracts as well. Give them what they want, and if one does not prove satisfactory, give them something else."

THE EDISON ELECTRIC ILLUMINATING COMPANY,
OF NEW YORK,
16 and 18 Broad Street.

Spencer Trask, President.
John I. Beggs, Vice-President and General Manager.
J. B. Skehan, Secretary and Treasurer.

NEW YORK, Dec. 17, 1888.

E. H. Johnson, Esq.,
President Edison Electric Light Co.:

DEAR SIR: Replying to your inquiry as to the accuracy and degree of reliance placed upon the Edison meter in the commercial transactions between this company and its customers, it affords me pleasure to state that our experience has established confidence in the meter, not only on our part, but also on the part of our customers, in consideration of which I offer you the following facts:

The Pearl street station was started September 4th, 1882, and, with the exception of but two hours during the first year, has continued uninterruptedly to date.

The station is at present supplying current for 15,000 incandescent lamps and 150 h. p. of Sprague electric motors to 647 customers through a like number of meters.

Our bills are paid cheerfully, with but an occasional exception, in which instances a verification of the meter is had, and the customer thereby thoroughly convinced of its accuracy.

Repeated tests of the meter, comparative and otherwise, made by ourselves, show a maximum variation of not greater than 2 per cent. and a variation from accuracy of not more than 1 per cent. These tests, combined with the practical results of five years actual use of several hundred meters, have demonstrated conclusively to the company and its customers the efficacy of the apparatus for the purpose intended.

Yours truly,
THE EDISON ELECTRIC ILLUMINATING CO. OF NEW YORK,
By JOHN I. BEGGS,
Vice-President and General Manager.

The following, it is hardly necessary to say, was penned in the bracing air of the Rocky Mountains, and has the ring of Western enterprise:

"I can endorse the meter for two reasons. It is the friend of the poor man as well as the company, for the following reasons: It gets action on the horny-handed son of toil this way. Our contract price for lighting houses for five lights is $4.25 per month, or $51 a year. Now there are lots of customers who cannot afford to pay that, but can afford to have five lights installed and use the meter, which will probably not average over $2.50 per month, or $30 for the year. At the same time, if they should contract for $4.25 per month, and run some till 12 o'clock for a month, they would consume $13.50 per month (if measured by the meter), but we would only get $4.25. If all did this our load would overrun our capacity, but thanks to the little box—she holds her down. It produces the same effect with business houses. Our contract price with this class is $1.50 per month (all my figures are based on 16-candle lamps). Houses having 25 lights would be $37.50 monthly; by meter we would realize $29.10 average for year, arc lighting being 6 till 9. You see we get $29.10 light, while with contract they could burn till 12 for $37.50, or six hours light. The meter holds the load down for families when they use only one or two lights a night, but if contracted they would 'turn her loose, Murphy,' in order to play even. It is our experience that the people always manifest a desire to play even with a light company if possible, and if they can't get action one way they will another.

"Our meters are a great deal of labor, owing to the number we have in use, but still we can't get along without them, and really think they are reliable if conditions are equal. My tests here have been very flattering; have had them within ⅓ of 1 per cent. of bill, and the highest out was 2⅝ per cent. high.

"For customers using a large amount of light, it is cheaper for them to contract here, but for small customers the meter is the correct thing, and with us produces satisfaction and good results among the customers. In the summer bills are small, but the winter months balance them and run higher; when expenses increase so do the meter bills, but with contracts it would be the same."

The following extract from a letter from Mr. J. W. Lieb, Milan, Italy, written under date of November 2, 1888, demonstrates clearly how satisfactory the action of the meter may be made, even when the urgent cares of a rapidly growing business, forbid the one engineer of the station who is thoroughly informed on this subject, from giving the details of its operation any considerable personal attention. Mr. Lieb has labored under the additional disadvantage of being at a great distance from the birthplace of the system, and the scenes of its widest usefulness.

"We have at present actually in use in Milan some 360 meters of various types (all Edison meters), the smallest for 350 ampère-hours per month, and the largest 30,000 ampère-hours, with a respective maximum capacity from 4 to 400 ampères.

"All the current from the mains is paid for by the ampère-hour, according to the sliding scale of charges herein inclosed.

"The temperature to which the meters are exposed varies between 5 degrees Centigrade and 35 degrees Centigrade. We have never had occasion to apply thermostats to the meters. The results of our experiments and our general experience with the meter have given us confidence that, if carefully treated, its indications are fairly reliable, the maximum error (low reading) occurring with light loads.

"While we have some consumers whose consumption of current is comparatively uniform throughout the year, the majority (among whom many apartments) consume little or no current during the summer months, some consumers closing their apartments and making the meters inaccessible for four or five months.

"Our consumers are as a rule very close, a number keeping careful account of their lamp hours (ampère-hours) from month to month, the larger ones having clerks specially delegated for that purpose.

"This fact, coupled with the unfavorable conditions of supply above noted, makes it necessary to apply allprecautions to avoid contestations, and I am glad to say we have been fairly successful in meeting the difficulties.

"We keep a careful half-hourly register of the indications of the main station ammeters and the feeder ammeters, and find them to agree with each other, and their sums with the ampère hours given monthly by the meters within a small percentage of error which we have observed is a maximum during the summer months, the sum of the meter indications being slightly low."

The reports referred to represent the following aggregates and averages:

Total number of lamps of all powers in 23 stations	117,501
" " " " on meters	87,856
" " " " on contracts	29,305
" " " motors	350
" horse-power of motors	1,000
" number of meters of all capacities	5,187
" " " two-wire meters	4,531
" " " three-wire meters	660
Average number of lamps per station, meters and contracts	5,109
" " " " on meters, 23 stations	3,820
" " " " on contracts, 20 stations	1,465
" horse-power of motors	3
" number of meters per station	226
" " " lamps per meter	17
Total cost of operating 16 systems	$16,235.00
Average annual cost of operation per meter	4.03
" " " " " " lamp	0.22

It is also of interest to note that of the 23 stations equipped with meters for the measurement of 75 per cent. of their entire

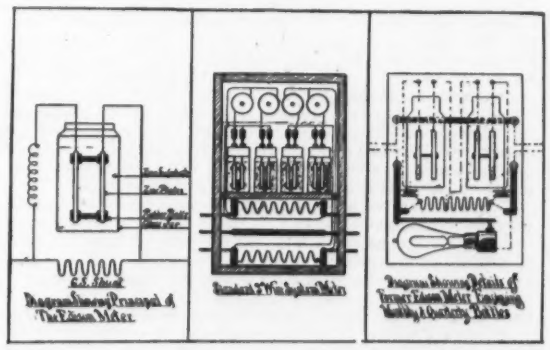


FIG. 19.

lamp capacity, and relying upon these meters for the amounts of their bills to consumers, four are earning upwards of 15 per cent. on their capital stock: three others between 10 and 15 per cent.; three others between 8 and 10 per cent., and eight more between 5 and 8 per cent. on their capital stock. Others have been operating for too short a time to yield definite results.

I have not taken your time this evening to prove by aggregation of testimony simply that a meter basis is the proper principle, or that the electrical fraternity needs it and should be educated to its use. This is self-evident. My aim is to show by the incontestable logic of facts that it is entirely practical and economical to accomplish all that is required by a method which is widely applied, and to emphasize by varied but singularly harmonious quotations from the experience of men who are by its help earning dividends, the result of "Six Years' Practical Experience with the Edison Chemical Meter," which is the topic of my paper.

DISCUSSION.

Mr. E. P. ROBERTS: I would like to ask the lecturer if there is any basis to the length of time to weigh up, and do all the registration necessary, say, on 100 meters; *i. e.*, the time required to do the manipulation necessary to arrive at the figures.

Mr. JENKS: I think, perhaps, a fair approximation to that may be reached by the averages which were given on the number of meters per station, and the average expense. The number of meters per station on an average in 18 stations being 225, and the axerage expense being $4 per meter per year, it would make a 225 meter station cost $900 a year, in the man and chemicals, and everything else required. In other words, a station of that kind would represent just about that amount of running expense after the plant had once been installed. There are several records of one

man attending to a great many meters; but I think, perhaps, experience has shown that men vary in their ability to do that sort of work just as they do in the trimming of arc lamps, or anything which requires care, and at the same time rapid manipulation.

Mr. ROBERTS: Who does that work usually, the book-keeper?

Mr. JENKS: That depends to a considerable extent on the size of the station. In a very small station, say a 1,000-light station, the superintendent does his own meter work, and can do it without any difficulty. There are two or three superintendents now, some of the oldest men in the Edison business, who, with 2,000 lamps installed, take in the bottles and replace them themselves. When the station gets a little larger a boy is employed to do that merely mechanical work. Then the time comes when the meter man, who should be an intelligent man, does simply the weighing, and all the other mechanical parts of the business are done by a number of people. Then, instead of making out the bills himself, he simply sends the weights to the book-keeper or the superintendent; so it comes that we have all the way from, we might say, one-half, to three and four or five men employed in the meter business, according to the size of the station.

Dr. WHEELER: Mr. Jenks, in describing the 3-wire meter, omitted to explain the way in which the two sets of boxes take care of the 3 wires. I would like to call his attention to that. The current, in going out on the positive wire, for instance, is registered in the positive bottle. It may return through the neutral wire, and it may return through the negative. In that case it is registered in the negative bottles. After returning on the neutral wire, it is registered again. The passage of the current through this wire causes it to consume another 110 volts, so that it should be charged up twice.

Mr. JENKS: I neglected to make it plain that the neutral wire acted as a compensaiton for the meter, as well as for the line service.

Mr. J. HOWELL: There is one point in the criticism which Mr. Jenks quoted from the past proceedings, which, I think, ought to be mentioned. That criticism stated that you are measuring only a very small proportion of the current which you are selling, that is, a 975th part, and that any error in the measurement was multiplied by 1,000 times, practically. Well, that is true; and yet it is not true. Although we measure a 1,000th part of the current and multiply by 1,000, any error in the measurement is not multiplied. If we measure 1,000th part of the current, and multiply by 1,000, any error in that measuring bottle in the resistance of the circuit in which the measuring bottle is placed is multiplied by 1,000; but the percentage of the error is always the same, and if we have an error of 10 per cent. in the circuit in which the bottle is, it means an error of 10 per cent. only in the result. No matter what kind of meter it is, whether that bottle is in the main circuit or in the shunt circuit, a two per cent. error would be a two per cent. in every case, and it would not be multiplied by 2,000 per cent. error in one case, as the criticism would lead you to believe. There are a good many men here whom I should like to hear from about meters. I have watched the introduction of the Edison meter, in one place especially, and I have watched its growth from the very beginning. When the Edison meter was first put into stations, the first thing a man asked was, "Is the Edison meter accurate?" And, really, there was, for some time, a diversity of opinion among the Edison people as to whether it was really an accurate meter. But the experience of the users of the meters has been so gratifying, and it has been so much to the credit of the meter, that you very rarely hear the accuracy of the Edison meter questioned to-day; in fact, among the Edison electric light people it is not questioned at all. It is known that the experience of the people using it for the last six years has shown beyond question that the Edison meter is accurate. The station I spoke of is the station at New Brunswick, which started out not to use any meters. They would make a contract with a consumer, and give him such light as they thought he would burn, at a fixed rate. The more they used that system, the more they were convinced that they were only getting about one-third as much for their current as they supposed they would get. To overcome that they introduced the meter system, and the result of changing from the contract to the meter system has been a very much diminished output in the station, and a very much increased revenue. They get twice as much in return for a given output of electricity as they did before. The accuracy of the meter down there has been checked several times by the customers counting their lamp-hours. I have never heard of a case down there in which the customer got the best of the meter—I mean in which the meter was found to be wrong. I know of cases there where the electric meter has checked the gas meter; I mean has differed materially from the gas meter.

Mr. UPTON: I would only add to what has been said here about the meter my knowledge of the very long course of experimenting that Mr. Edison went through to obtain the results that we now have. I know that in the early days at Menlo Park, these various forms that have been shown on the screen were made and tried. I realize very fully the difficulties in making any mechanical meter, or any meter that will not stick at starting. I do not think that those who have given attention to the meter have thought that any solution can be found; but this trouble will come in, except with a chemical meter. In the meters that use the heating principle, as we have shown, the sticking of the meter is an uncertain quantity, and is invariably against the company; those meters will never be used. If the error were in favor of the company, I have no doubt they would be largely sold and largely used, but they are invariably against the company.

Mr. EDGAR: We are using 800 meters in Boston, and I have the utmost confidence in them. I have tested a great many, and I have had our customers test them for us. I have known of numbers of cases where they have proved within one per cent., and I never have known of a case where we had to retreat from the position which we had taken that the meter was correct. We have had a great number of meters, and are able to determine just exactly the h. p. hours per month of each meter; thus being able to make a contract price in the next case which would be more satisfactory than if we had not made those tests. One gentleman asked a question to-night as to the cost of a meter station. We have, as I say, 800 meters. In that department there are five men; three of them are, practically, boys who go around town collecting bottles. We extend over a territory nearly three miles from one extreme to the other. Of course, the traveling is more than it would be for a different sized station. The fourth man does the weighing, and the fifth man makes out the bills, and sends the bills up to the book-keeper, ready to be mailed, so that we really do more in the meter department than is usually done in a department of that kind; because, usually, the bills are made out by the book-keeper. It costs, perhaps, $2,500 a year to take care of the 800 meters; but a great many, as I say, are on motors where we are experimenting, making changes once a week, so as to get at a fair average for different classes of work.

Mr. HOWELL: I suppose every one here knows that there has been a great deal of inventive energy wasted on meters. The records of the Patent Office show an enormous number of mechanical meters; and I think the Edison Company have had about as many presented to them as anybody has; and the great point in favor of the Edison meter, as compared with any other meter, is its cheapness. If we want to equip a station with 800 meters, as Mr. Edgar says his station is equipped, it makes a very great difference if we have to pay for a complicated mechanical contrivance, which is necessarily expensive, or whether we have to buy a box, with a couple of pieces of German silver and two bottles in it. The element of first cost is a very strong element in favor of the Edison meter. You can pay for your meters almost as much as you would for the station itself. A successful meter must have two qualities: it must be good, and it must be cheap; and, I think, the Edison meter has these two qualities very pre-eminently.

Mr. ROBERTS: As to the matter of mechanical meters, etc., I rather question whether we cannot some day arrive at a mechanical meter which will be satisfatory. So far as cheapness is concerned certainly a Waterbury watch is as cheap as those two bottles and two pieces of German silver, yet there is a great deal of mechanism in it. I wish to bring up one point showing how the customer, if he finds any expense kicking up against him, will want to economize. A station I know of has a 12×36 Corliss engine. The lamp renewals are paid for by the company, at the lamp contract price, and everything was running beautifully, and the engine was supposed to be developing about 65 h. p. (the indicator card showed about 100 h. p.), from 6 o'clock in the evening to about ten, then it dropped down somewhat. The system of charging for lamps being about 75 cents for a lamp, the customer expected it was to burn about 1,000 hours. As soon as he got a bill the indicator card then showed that the average number of lamps per horse-power was from 6 to 10, and that the engine was 75 h. p. Therefore, they saved over 25 per cent. of power just as soon as the customer felt that the lamp breakage alone was being charged against him. I do not doubt the gentlemen who have had the contract and the meter system besides can show even more remarkable figures than these.

Mr. CH. WIRT: I may say that there has been practically concluded now a series of experiments on the meter, and they are getting ready to offer a new meter, which will be a great deal better in many respects, *i. e.*, in the cost of the meter, in the decreased cost of operating, and in the much less strain on the meter man's back. It appears to us that, given a spool with a piece of German silver, the Edison meter depends on the laws of electrolysis and chemical balance, and the chemical balance is probably the best and most reliable and most sensitive instrument known. So it appears to us that we do not need any large quantity of zinc to weigh or to carry about, and we propose to reduce it one-half, in some instances one-fourth and in some instances one-eighth; so that the box will be about half the size it is at present. The bottle will be half the size it is now. In place of two bottles there will be one bottle. We will call on the balance for the accuracy we can get out of it, and call upon the meter man for a little more pains.

The Sellon-Julien Interference.

In view of the discussion that has arisen over the recent action in the U. S. Patent Office, in regard to the Julien storage cell, the opinion and decision of Commissioner Benton J. Hall are of more than usual interest, and are given below:

Sellon vs. Julien—Secondary Batteries—Motion to Dissolve.

Application of John S. Sellon, filed April 26, 1887, No. 236,208.

Patent No. 347,300, granted Edmond Julien, Aug. 10, 1886.

Mr. William B. Van Size for Sellon. Messrs. Knight Brothers for Julien.

This interference has been declared between the following claims:

Sellon's claim:

"In a secondary battery a plate element or support, containing lead and antimony, in combination with the active material."

Julien's claim:

"In an accumulator, the combination of support plates formed of an alloy of lead, antimony and mercury, an active matter consisting of a metallic salt applied to said plate after the latter is formed, and a suitable conducting liquid, substantially as and for the purpose set forth."

Julien is a patentee under a patent dated August 10, 1886. Sellon's claim was inserted by amendment in his application filed April 26, 1887. Julien's patent was thus issued eight months before Sellon's application was filed. The point at issue between the two parties is whether a plate or element in a secondary battery containing lead and antimony in combination with an active material, possesses the same identity as to construction and function as a plate formed of an alloy of lead, antimony and mercury.

There can be no doubt whatever with reference to compositions, that a party who attempts to improve upon an invention cannot, by the addition of some immaterial and functionless matter or element, destroy the identity of an invention and claim the new arrangement or combination to be patentable. In this case, if the addition of mercury to the two elements of lead and antimony is an unimportant addition, neither in itself nor by reason of its effect upon the other two produces a new function or enables the old function to be performed in an appreciably new and better manner, then it would be a mere equivalent or imitation, and undoubtedly the interference ought not to be dissolved.

Sellon insists that the claim made by Julien is a mere equivalent of his claim, and that the addition of the mercury is only a feint or method of evading the real subject matter in interference. On the other hand, Julien claims that the addition of mercury to the combination produces a new result, or, at least, an old result in a so much better and more successful manner, that it is an independent invention, for which a patent should issue, and that there is, in fact, no interference whatever between the two claims.

Several affidavits have been introduced by the respective parties in support of their various theories and propositions, and I have given the subject a great deal of consideration and have taken the advice of those who are skilled and expert in such matters, and I appropriate and embody in this decision the conclusions as follows: The composition of plate of Sellon's secondary battery contains two metals: first, lead; second, antimony. The plates of Julien's secondary battery contains three metals: first, lead; second, antimony; third, mercury. The value of these three metals as components of battery plates would be as follows: Lead, the chemical element, is the working material of secondary battery plates, but it is too pliant, soft and yielding when used alone, and hence it is usually mixed with another metal to diminish its softness and yielding quality, and the metal selected for this purpose is antimony, whose physical qualities of hardness, stiffness and slow oxidation give the properties to the alloy which makes its union with lead so useful in some arts, as in that of type founding, giving it hardness and rigidity and resistance to pressure. These properties of antimony are ordinary physical properties, and are not considered electrical properties, and if added to electrical batteries, or found in them, are not added to increase the electrical value of said batteries, whether secondary batteries or ordinary batteries, but for the properties well known in the arts, as in type founding, and harden the structure of the alloys to which they are added.

The addition of mercury as a battery constituent is of great value in the formation of support plates of secondary batteries, on account of its tendency to unite with the other metal or metals of the plate, forming a more active union or contact between the plate which contains an admixture of mercury, and thus diminishing the resistance of the electrode, and therefore the resistance of the whole battery, thereby increasing the current, which is a result of the greatest importance in the use and application of secondary batteries. This property (that of diminishing the resistance of the electrodes) is so valuable, that in the manufecture of plates for contact batteries, the addition of mercury to alloys of lead and antimony gives marked advantages over batteries formed of lead and antimony alone, and renders them preferred for secondary battery purposes. This is the characteristic value of the Julien battery or the *triple alloy battery* of Julien, which is so much preferred in modern use on account of its durability and efficiency.

The action of mercury in the three element battery—that of Julien—should at once remove it from comparison with two metal batteries of any kind as yet known, and which appears to be due to the admixture of mercury in the alloy, which renders it unlike the other batteries with which it is classified wrongly in this interference, and with which it should not have been placed in interference, for the presence of mercury in the plate gives it a distinct and separate place and forms a different alloy.

The action of the primary examiner in denying Julien's motion to dissolve is reversed and the interference is dissolved.

The Provisional Programme of the International Electrical Congress of 1889.

The following is the programme which the Executive Committee propose to lay before the forthcoming International Congress of Electricians at Paris next year:

FIRST SECTION.—MEASUREMENTS.

Units of measurement. Recent determinations of the unit of resistance. The ratio of the electro-magnetic to the electrostatic units. New names for practical units. Measuring instruments. Resistances. Alternating and continuous currents. Electromotive forces. Capacities. Co-efficients of induction. Practical standards of current and E. M. F. The magnetic and electrical properties of metals.

SECOND SECTION.—DYNAMO MACHINES, MOTORS, ELECTRICAL DISTRIBUTION, TRANSFORMERS.

Recent progress in the theory and construction of dynamo machines. Different methods of calculating the data of a machine. Electro-magnetic armatures with iron cores. Electro-dynamic armatures without iron. Machines for lighting, transmission of power (generators and receivers), electrolysis. Output. Machines for distribution. Different methods of automatic regulation. Mechanical and electrical methods. Transmission of power. Mains. Central stations. Possibility of constructing very large machines. The employment of many small machines, or of a few large machines. The advantages of coupling machines in parallel or of running independently. Transformers. Alternating-current and continuous-current transformers; the two systems compared. Alternating-current transformers; their theory, improvement, efficiency. Different methods of distribution. Automatic regulation. Alternating-current dynamos and motors, compared with continuous-current machines. Discussion with regard to the machines and other apparatus used in continuous-current distribution and in alternating-current distribution by means of transformers.

THIRD SECTION.—ELECTRO-CHEMISTRY.

1. *Batteries and Accumulators.*—Practical value of the chief types employed; E. M. F.; output, durability, etc.

2. *Electrolysis.*—The E. M. Fs. necessary to decompose the ordinary iron compounds. The conditions necessary for a good deposit of the ordinary metals, copper, silver, gold, nickel, platinum, etc. Current densities, composition of baths, temperatures, etc., required for the various kinds of deposits.

3. *Electrometallurgy.*—Principal methods of separating and refining metals. The production of metals and alloys by electric furnaces.

FOURTH SECTION.—LIGHTING.

Respective values of arc and incandescent lighting. Advantages and disadvantages of high candle-power incandescent lamps. Methods to employ when running arc lamps in series or parallel, without rheostats between the lamps and the machines. Best methods of manufacturing incandescent lamps with a view to increasing their life and efficiency. Best methods of erecting and working central lighting stations.

FIFTH SECTION.—TELEGRAPHY AND TELEPHONY.

1. *Telegraphy.*—The employment of dynamo-electric machines. Underground wires, their employment, laying and life. Telegraph lightning arresters. Fast speed transmitters: their working and employment. Multiplex apparatus.

2. *Telephony.*—Running wires; steel, bronze, hard-drawn copper, compound wires. Insulators. Joints. Posts and stays. The employment of overhead and underground wires. Dampers. Methods employed to overcome mutual induction. Metallic circuits. Simple or multiple switch-boards. The number of subscribers served by one operator: the number of connections which can be made by one operator in an hour; the time necessary to make a connection. Interior economy of exchanges. Rules for subscribers. The repair and maintenance of subscribers' instruments. Microphones. Batteries. Running several instruments on the same line. Statistics. Legislation. Development of the system. Tariffs. Automatic Posts. Interurban telephony.

3. *Various Applications.*—Electricity applied to railways, to civil engineering, to military and naval purposes, to clocks, to chronography.

SIXTH SECTION.—ELECTRO PHYSIOLOGY.

Comparison of the effects obtained when using various kinds of electro-medical apparatus. The necessity for defining the currents employed in medicine and connecting them with the usual electrical units. The best methods of determining the exact nature of electric phenomena in animals. The effects of alternating and continuous currents on living beings. Electrolysis of the tissues. Dangers of electrical installations. The conductivity of organic bodies, especially that of the human body.

Why Gas-Main Conduits are Safe.

To the Editor of The Electrical World:

SIR: In your issue of Dec. 29 is a communication signed A. R. P. on "The Danger of Gas-Mains as Electrical Conduits." The writer is apprehensive of danger from the accidental ignition and consequent explosion of gas in the mains should a spark pass. Illuminating gas will not ignite or explode unless mixed with oxygen, or air containing oxygen, and as this mixture does not exist in the mains, it follows that there can be neither ignition nor explosion. Gas is produced in red-hot retorts and is passed through red hot tubes in some processes of manufacture without danger from explosion when unmixed with air. It is the popular belief that gas is explosive because explosions have occurred in the streets and houses from escaping gas, but in all cases the explosion is caused by a mixture of gas and air. Were it the fact that gas is explosive it would be unsafe to light a burner, as the fire would "follow back" into the pipes and explode the gas as quickly as an electric spark. B.

[We have received letters to similar effect from "A. S. G." and "M. J. M., Jr."—EDS. E. W.]

Prices of Copper.—It is said that owing to a new deal contemplated or going into effect between the copper syndicate and the American producing companies, the price of the article is liable to make a jump.

Executions by Electricity.—District Attorney Fellows says that the clause of the law for the execution of death sentences by electricity which forbids newspapers from printing the description of an execution is clearly unconstitutional. "Among those whom the Sheriff has a right under the law to invite to witness the execution, there is no reason why newspaper reporters may not be invited. In fact, they probably will be present. If they were not invited what is there to prevent myself or any one else present to recite the facts in conversation after the execution is over? To forbid that I should recite the facts would be to forbid free speech. And, furthermore, what does a reporter do but recite the facts to half a million readers instead of to a group of friends. Of course, if an indictment should be found against an editor or reporter for printing and reporting the execution I should be compelled to prosecute; but, in my opinion, the judge would hold the law to be unconstitutional, or at any rate, the trial would not result in a conviction."

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
168-177 POTTER BUILDING, NEW YORK, Dec. 31, 1888.

The Cobb Vulcanite Wire.—A great many of your readers will be glad to know that the Cobb Vulcanite Wire Company, of Wilmington, Del., about whose product so much interest is felt, have taken a New York office at 45 Broadway, Room 68, with Mr. J. B. Ecclesine as their agent. At that place samples can be seen, and any desired information obtained.

The Callender Insulating and Waterproofing Company are sending out 15 tons per week of their Trinidad wire. "Bitite" is also holding its own and advancing in demand. The company are installing a number of new machines at their works to help meet the orders that are pouring in for their specialties. Good insulation was certainly never better appreciated than it is to-day.

The Macraeon Storage Battery.—I am glad to mention the fact that Mr. A. C. Kendall takes the management of the Macraeon Storage Battery, 7 Wall street. Mr. Kendall has had large experience in the storage battery line. He was busy last week estimating on some large plants and getting prices on 40,000 to 50,000 watt dynamos, for the generating capacity. The company, as I under stand, has ample backing so that it can readily undertake contracts to any extent.

The Brush Electric Company.—Under the direction of Mr. Hamill, the New York office is keeping up its record of activity and progress. It has just completed a new central station at Princeton, N. J., for Mr. C. S. Robertson, the editor of the Princeton *Press*. It has also recently completed a plant for the New Jersey State Reform School, of 500 incandescent lamps, operated by one machine of 450 light capacity, and one of 150. At the present time, it is installing a 20 arc light plant at Hendricks Brothers rolling mills, Soho, N. J.

The Continental Dynamo Company.—Mr. Peter Claus, an electrician formerly representing the Lahmeyer dynamo, with Mr. E. Imhauser, has taken the management of the Continental Dynamo Company, 42 Exchange Place, where he will be glad to receive all his friends, and to give quotations on arc and incandescent plants or for machines for electrolysis applied to depositing, of any size. He is now completing one machine of 60,000 watts, and a number of smaller sizes. The members of the Continental Company are men well known in banking and commercial circles.

Electric Light Fixtures.—The well known house of E. P. Gleason & Co. have just issued a new edition of their illustrated catalogue for electrical appliances for arc and incandescent lighting. It is a publication of over 150 pages, profusely illustrated, with as many as six and eight cuts on a page, and gives details with regard to all the plain and decorative fixtures which are now considered necessary in all the various classes of work, and which, practically, may be applied to any system. The catalogue includes glassware in great variety, outside lamps, vapor-proof globes, insulated wire for fixtures and electroliers, wire guards, tin and paper shades, pendants, brackets, double pole fusible cut-outs, moldings, cleats, ceiling plates, insulated joints, beacon and ornamental lamps, newel posts, etc. Altogether the catalogue is a most useful and comprehensive one, and evinces on every page the care and thought bestowed by this well-known concern in meeting all the wants of the trade, and in anticipating new ones.

Electric Gas Lighting.—Mr. A. T. Smith, 6 West Fourteenth street, has just brought out a new and novel electric gas-lighting cut-out. It is composed of a small upright tube, filled with sand. At the bottom of the tube is an opening about one-sixteenth of an inch, beneath which is a solid valve balanced from one of the two pillars which hold up the tube. The valve is operated by a magnet in the battery circuit whenever you light the burner and close the circuit, and which allows just a few grains of the fine sand in the tube to drop into the receptacle below. If, by accident, the circuit is kept closed either at the burner or elsewhere, the magnet will hold the valve open and allow enough sand to fall into the small conical vessel beneath. In about fifteen to twenty seconds, or any desired time, this vessel is over-balanced by the weight of the sand, and reopens the circuit, at the same time discharging itself of the sand, and going back to position. It will be seen that the principle is very ingenious and operative. The whole cut-out is put upon an oblong base, five by eight inches, with a glass vase covering it.

Electric Power.—Mr. Albert Gray, licensee under the Daft system for the transmission of motive power by electricity in this city, with power stations in Park place and Duane street, has issued a neat little pamphlet as to the work that he has done, and the advantages which the motor offers to small power users. This service practically replaces and extends a steam power distribution, which was founded about fifteen years ago. The limit at which power could be economically distributed by steam having been reached, it became necessary to resort to some other method, and this was found in the Daft motor system. Mr. Gray, under his agreement with the Electric Power Company, of this city, furnishes motors ranging from 1 to 25 h. p., and he does not sell his motors, but leases them at the rate of $4 per week for 1 h. p., $6 for 2 h. p., and $3 for every additional h. p., this including the current and use of the machine, the attendance and the necessary repairs. The pamphlet embraces a long list of the users of the service, with motors ranging from the smallest size up to 6 or 7 h. p., occupied on all classes of work.

A Beautiful Christmas Tree.—Mr. Frank A. Perret, electrician to the Elektron Manufacturing Company, makers of the Perret motors, dynamos, etc., assisted by Mr. R. C. Slee, decorated the Christmas tree at the festival of Christ Church, Brooklyn, on Friday last. The tree contained 130 six c. p. lamps fitted into fancy reflector shades made in numerous designs, and decorated with colored tinsel, which gave the prettiest possible effect when the current was turned on. Mr. Perret is to be congratulated upon the successful lighting of the tree, more particularly as the 21 storage batteries which were used to furnish current did not arrive at the church till 7 o'clock of the evening of the festival, and had all to be connected up in multiple arc; the Edison lamps were in multiple series of very low resistance. This is a good departure in illuminating Christmas trees for festivals, as the danger is avoided of firing the tree with candles, as well as the tedious work of lighting each separate candle by hand. The use of storage batteries is particularly new. Mr. Perret used them in this church three years ago, and has used them on other festal occasions in the church.

The Bathrick Electric Dissipator.—This patent apparatus, which is handled by J. H. Bunnell & Company, 106-108 Liberty street, is intended to be attached to printing presses, for the purpose of overcoming all trouble from electricity in printing. Those who have anything to do with press-rooms, know how great is the trouble in the winter months with electricity. This attachment frees the paper immediately from its charge, and will allow any number of sheets to be printed on one side, backed up and folded, and will also prevent the transfer or off-setting of impressions by the close electric adhesion of the sheets to each other. The firm will attach this dissipator to presses at shortest notice, and supply with it solution for dampening. It is said that with judicious use, one gallon of the solution will suffice for one press for a year. The apparatus is so simple that it in no way interferes with the work of the press. It has been tried by such large concerns as Harper Brothers, the Butterick Publishing Company, Rand, Avery & Company, all of whom speak most highly of it as an economical expedient, and permitting the use of paper of every kind. The Butterick Company state that by its adoption they have saved $30 a day on the cost of paper alone.

W. T. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
178 Devonshire Street, Boston, Dec. 31, 1888.

Change in Firm Name.—On and after Jan. 1, 1889, the firm name of Messrs. F. E. Pettingell & Co. will be changed to Pettingell, Andrews & Co.

"Clark" Wire.—The Eastern Electric Cable Company, Boston, Mass., has issued a very neat catalogue, containing wire tables and formula, with price-list of the "Clark" wire.

Personal.—Mr. Edward W. Rollins, President of the Denver (Col.) Electric Light Company, accompanied by his brothers, Messrs. M. Rollins, of Denver, Col., and Frank W. Rollins, of Concord, N. H., was in Boston during the past week.

Sprague Motors.—Messrs. Sawyer and Blake, N. E. agents of the Sprague Electric Railway and Motor Company, report a steadily increasing demand for electric motors for manufacturing purposes as well as for domestic use throughout this and neighboring sections.

A New Electric House.—Messrs. T. C. Perkins & Co. have established themselves in business as general electrical contractors in Hartford, Conn. They will manufacture and deal in electric light supplies, and will contract for electrical construction work of all kinds.

New Station.—The new and mammoth electric light station of the Boston Electric Light Company is nearly finished. The building is just at the rear of the Hathaway Building, on Atlantic avenue. Within a fortnight the machinery and electrical equipment will be in position.

Personal.—Mr. Charles Jacobs, formerly with the Wainwright Manufacturing Company, has taken the Boston agency for the Hohenstern "Common Sense" feed water heater and the "Goubert" water tube feed-water heater. Mr. Jacobs has pleasant offices at No. 55 Oliver street.

Acoustic Telephones.—The National Telephone Manufacturing Company, Boston, Mass., is doing a remarkably flourishing business for an enterprise of only a few months' active operation. Manager Bennett assures me that his company is receiving orders from nearly every section of the country.

Edison Isolated Incandescents.—Messrs. Paine & Francis, the New England agents of the Edison United Manufacturing Company, have completed the installation of isolated incandescent plants as follows: 450 lights at the new building of Messrs. Cobb, Aldrich & Co., Boston, and 400 lights at the factory of the Pearson Cordage Company, Boston.

Siebert Oil Cup.—The "sight-feed" device of this popular oil cup has made for itself an extensive and rapidly growing demand in nearly every place where there exists an electric station. The Siebert Cylinder Oil Cup Company, of Boston, report having received specially large orders this season for their new engine and dynamo bearing cups with visible feed.

Goldsmith Valves.—Mr. Wm. T. Andrews, who has established well appointed and commodious offices at No. 55 Oliver street, Boston, is the sole agent for the Goldsmith valves. For use on steam engines and boilers these valves are said to have no superior in the market, and many electric light people, as well as manufacturers, are showing their appreciation by adopting them.

The Stellar Incandescent Lamp.—The company engaged in the manufacture of this lamp has adopted a new socket, the invention of Mr. F. M. Brown, a prominent electrician of this section. This socket—although quite simple in appearance—possesses remarkable strength and works very easily. The Stellar lamp has already acquired a reputation for long life and as giving a satisfactory light, and the new socket seems certain to enhance the popularity of the former.

Fuller, Holtzer & Co., of Boston, report business as active and satisfactory. This well-known firm are wiring the Fiske building on State street for nine hundred Edison incandescent lights; also fitting up the new hotel at Harvard Bridge, corner Beacon street and West Chester Park, for three hundred and fifty Edison lights; the Niles building on School street five hundred Edison incandescents, and the Hunnewell building, on same street, for two hundred and fifty Edison lights.

A Bridgeport Enterprise.—Among the new enterprises started in Bridgeport is the Star Electric Company, of which Mr. C. D. Miller is the manager. They opened business there in July last, and are now reaping the benefits of a good trade. They carry a large line of first-class electrical goods, ranging from a common call bell to the largest dynamo for electric lighting. During the past month they have closed contracts with parties at Rochester, N. Y., Norfolk, Va., and Hot Springs, Ark., beside the Bridgeport Malleable Iron Company and the Bridgeport Rolling Mill Company, of that city, for using the American system of arc lighting, for which this firm are agents as well as for the Edison system. They are now negotiating for the construction of several large plants, one in the West Indies that will require over forty tons of electric machinery and appliances.

A Trip Over the Electric Road.—On Wednesday of last week, in company with Messrs. Sprague and Gilley, I was the recipient of courtesies at the hands of Messrs. Sawyer & Blake, agents of the Sprague Electric Railway and Motor Company, and Mr. W. D. MacQuesten, the construction agent of that company. A delightful ride by carriage from the city to the town of Allston, under the care of Mr. F. J. Sawyer, was much enjoyed. Mr. MacQuesten kindly escorted us through the dynamo-room of the power station and explained the various machines and minor apparatus, together with many interesting features about the plant, all of which was fully set forth in THE ELECTRICAL WORLD of last week.

After an enjoyable hour passed at the station, Mr. MacQuesten had one of the electric cars brought down from Brighton and placed at our disposal. With Messrs. Sawyer and MacQuesten at the switch the car started off, and moved over the Harvard avenue tracks easily and gracefully. At times the car was run at the rate of fully fifteen miles per hour, and the distance covered between the Allston Power Station and Harvard Bridge—about seven miles—was accomplished in 22½ minutes. Not a mishap nor a hitch of any kind occurred throughout the trip.

Early last week I also took advantage of the invitation kindly extended me by President K. M. Jarvis, of the Jarvis Engineering Company, and accompanied that gentleman to Allston and there visited and inspected the power plant of the West End electric road. The dimensions of the boiler house are as follows: Twenty feet high, 38 feet long and 36 feet wide. The engine and dynamo room is 15 feet in height, 50 feet in length and 36 feet in width. In the boiler room are three tubular boilers, manufactured by Messrs. E. Hodge & Co., East Boston, set with the Jarvis patent furnace and Sheffield grate bar.

Mr. Jarvis invited my attention to the new and novel construction of the furnaces, the mouthpieces being faced with fire-brick instead of the old-style iron facings. This new departure, it is claimed, will prove less expensive in the fitting up of the furnace, and will enhance its durability and cleanliness. The National feed-water heater is used in this plant, and is of 500 h. p. capacity. Near by are Hancock inspirators and Korting injectors, a Spencer automatic damper regulator, and a Davidson pump. The smokestack is built of the finest brick, and is 100 feet high.

The engine and dynamo rooom is immediately adjacent to the boiler room, and its equipment has been installed with excellent taste and good judgment. Two enormous 200 h. p. Armington & Sims engines stand side by side at the west end of the room and each is belted to two Edison dynamos of the No. 32 pattern. These engines are the largest size manufactured of the high-speed type. They run at 200 revolutions when operating the dynamos. The Jarvis Engineering Company, of Boston, erected the power station and furnished and fitted up the entire equipment for the steam plant, including the boilers and engines. Mr. Jarvis, the president of the company, assisted by Mr. E. S. Cobb, gave his personal attention daily to the erection and the fitting up of this handsome power station from the very day ground was broken. The work is complete, and the contract between the West End Company and the Jarvis people has been faithfully fulfilled by the latter, and in a way highly satisfactory to all concerned. The power station, as it now stands, is just one-half the size of what the plans specify. In the spring the wall of the station facing the B. & A. R. R. track will be removed, and the building will be enlarged to double its present dimensions, and the steam plant and electrical equipment will also be duplicated.

W. I. B.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
39 South Tenth Street, Philadelphia, Pa., Dec. 29, 1888.

Mr. Cleverly's Christmas.—Mr. H. A. Cleverly, manager of the Cleverly Electrical Works, 1,018 Chestnut street, displayed his generosity the day before Christmas by presenting each of his employés, from the superintendent down to the office boy, with a fat turkey for their Christmas dinner. It is hardly necessary to add that the birds were thoroughly enjoyed by the faithful employés of Cleverly's establishment.

New Charters.—Among the charters granted at the State Department last week were these: The Lackawanna Electric Light, Heat and Power Company, of Taylorville, Lackawanna County; capital, $5,000. The Jefferson Telegraph Company, of Pittsburgh; capital, $10,000. The Pittsburgh Electric Railway Company; capital, $18,000, and the Pittston Electric Railway Company, which is authorized to build a street passenger line six miles long.

A Proposed City Plant.—Councils' Joint Special Committee having charge of the proposition for the city to establish an electric light plant met last Friday. A statement was made to the effect that the city was now paying $129,000 per year for 755 electric lights on the streets, when, for $300,000, a plant could be erected that would furnish 3,000 lights at an expense of $90,000 per year. In view of the award of contracts for next year it was decided to first consult the directors of Public Works and Public Safety before taking any definite action.

Patent Litigation.—An equity suit was recently begun here in the Common Pleas Court, by Mr. J. A. Timmis, against the Currie-Timmis Electric and Railway Supply Company, Limited. Mr. Timmis says that himself and Mr. Currie, in May, 1887, owned jointly four patents for an electro-magnet and armature and a railway signal; that he gave to Mr. Currie a power of attorney to sell his (Timmis') interest in the patents under certain terms and conditions; that the defendant did not comply with the authority thus conferred, but entered into an illegal and unauthorized agreement with William H. Johnstone and George R. Thompson, by which the above-named company was formed. The result has been that the complainant has received neither cash for his share of the patents nor stock of the company. He asks the Court to decree that the defendants and the company shall reassign and reconvey to him his half interest in the patents.

City Lighting.—Director Wagner, of the Department of Public Works, and Chief Walker, of the Electrical Bureau, have opened proposals for furnishing electric light for the streets next year. The lights must be of the arc system, and the director reserves the right to reject any not up to the standard. It is required that the lights shall burn from sunset to sunrise, and those burning less than nine hours per night between Sept. 1 and March 31, or less than six hours per night from April 1 to Aug. 31, will not be paid for. Any violation of the specifications will cause an annulment of the contract. The prices, which average about 2¼ cents less per night than this year, were as follows: Germantown Electric Light Company, 55 cents a lamp; Frankford Electric Light and Power Company, 55 cents; Northern Electric Light Company, 48 cents; Brush Electric Light Company, 45 to 50 cents; United States Electric Light Company, 49 cents; Philadelphia Electric Light Company, 45 to 47½ cents; Wissahickon Electric Light Company, 55 cents. The companies do not conflict in territory, and all received contracts.

E. W. E.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
44 Lakeside Building, Chicago, Dec. 29, 1888.

Lighting the Tacoma Building.—The Tacoma Building, the new twelve-story structure, corner of LaSalle and Madison streets, is to be lighted by 2,000 incandescent lights. The contract has been awarded the Chicago Edison Company.

Belting for Dynamos.—The Chas. Munson Belting Company report recent sales of their special dynamo belting to the following: Metropolitan Electric Light Company, St. Louis, Mo.; Cedar Rapids Electric Light and Power Company, Cedar Rapids, Ia.; Clinton Electric Light and Power Company, Clinton, Ill.; Champion Electric Light Company, Springfield, Ohio.

Large Demand for Wires, Cables, Etc.—Activity in electrical matters is evidenced by the demand for electrical goods. The Central Electric Company tell me that they have had a regular cyclone of orders for wire, cables, etc., having within the four days sold some 30 miles of the popular brands of Okonite and Candee of the largest sizes. The pin and bracket factory of the company is taxed to its maximum to furnish those staple goods.

The demand for the Stoddard cut-out is brisk, as is also that for carbons.

Lights in the Chicago Opera House.—Electric lights in the Chicago Opera House were considerably damaged by the recent fire which occurred in that building. The theatre is to be opened on Monday next, and the repairing of the lights has just been undertaken by the Chicago Edison Company, F. A. Sargent, Superintendent. Quick work will be required to have them in operation by that time, but Mr. Sargent says he will accomplish it.

Sale of Thomson-Houston Lights.—The Western Department of the Thomson-Houston Company has just sold 30 arc lights to Burlington, Kan., for a central station; 35 arc lights for a central station at Richmond, Mo.; 500 incandescent alternating lights to the Gas Company, Lansing, Mich.; 200 incandescent lights to Cantine & Co., Crestline, Ohio; 200 incandescent lights to the Belding Mfg. Co., Belding, Mich., for lighting their works.

Telephone Quotations.—Col. S. G. Lynch, broker, 146 La Salle street, furnishes quotations upon telephone stock as follows:

Bell of Mo.	$149@$152	Iowa Union	23@ 25
Central Union	47@ 48	Michigan	78@ 79
Chicago	325@ 330	Missouri and Kansas	69@ 70
Colorado	40@ 41	Rocky Mountain Bell	39@ 40
Cumberland	65@ 68	Wisconsin	115@ 117
Great Southern	30@ 35		

The Council Bluffs & Omaha Electric Railway.—In conversation with Mr. Theo. P. Bailey, of the Railroad Department of the Thomson-Houston Company, a few days ago, he said with reference to the Council Bluffs electric road that it started up on Dec. 10 and has been in constant operation ever since, not having missed a trip. The management express themselves as thoroughly satisfied with the operation of the road, and in their opinion the electric railroad is as much superior to cable as the cable is superior to the horse cars.

The Ft. Wayne Jenney Company.—I learn through the Western branch of the Ft. Wayne Jenney Company that the company have secured temporary arrangements for the manufacture of incandescent apparatus in the large foundry of Kerr Murray Machine Company, manufacturers of gas machinery. Inside of two weeks they expect to be turning out machines, as they have patterns and everything in readiness. None of their contracts will, they say, be much delayed, and they are accepting all new contracts offered them. The company propose to rebuild.

Combining Temperature Interests.—I learn from Mr. A. M. Butz, the manager of the Illinois branch of the Consolidated Temperature Controlling Company, of Minneapolis, Minn., that the National Electric Service Company, operating under the Johnson patents, have acknowledged that the fundamental patents as adjudicated by the United States Court at Milwaukee, Wis., are held by the Consolidated Temperature Controlling Company, who agree to pay them a bonus for the privilege of using such patents and have united with them to prosecute all infringers of any electric temperature controlling device. They have brought suit, he states, against the Guion Company, of Elmira, N. Y., and the Sparrow Company, of Boston, Mass.

Westinghouse, Church, Kerr & Co.—The Keystone Construction Company, of Pittsburgh, have established a Chicago branch, occupying offices with the above named firm. This company will do exclusively construction work for the Westinghouse systems of electric lighting, co-operating with Westinghouse, Church, Kerr & Co. in their specialties. This branch of Westinghouse, Church, Kerr & Co., I may add, is very busy just now with sales of electric light engines. The Roney mechanical stoker, manufactured and sold by this company, is meeting with great success, among the contracts for same just closed being one for the equipment of the Spreckels Sugar Refinery in Philadelphia. The electric light plant now being installed at Cedar Rapids, Iowa, of the Westinghouse system, will probably be started this week.

The East Cleveland Electric Street Railway.—During the last week several experimental trips have been run over the East Cleveland Street Railway on Cedar avenue, and it is now expected that the road will be in commercial operation and ready to carry passengers in about ten days. This road extends out on Euclid avenue from the city of Cleveland to East Cleveland, through the finest residential streets. The power-house is of the finest character and fully equipped with all the necessary electrical apparatus. The generating apparatus includes four 500 volt dynamos of 40,000 watts capacity each, representing 375 h. p. The building is so arranged that this can be easily increased, and without changing the line of machinery, 1,500 h. p. of dynamos can be placed in position. The street car equipment will include sixteen Sprague improved electric motor-trucks, with all the latest devices and applications adopted by the Sprague Company. The overhead system will be the regular Sprague type, and although the poles will be of wood, they will be painted and of a neat design, so as to be neither ungainly nor noticeable. All the cars will be lighted by electricity, and will be equipped with the Sprague lightning arresters.

E. L. P.

KANSAS CITY, Dec. 22, 1888.

Springfield, Mo.—At last week's council meeting at Springfield, Mo., a number of electric railway men presented to the councilmen the points in favor of the railway systems which they represented. J. J. Everingham, of the Kansas City Agency of the Thomson-Houston Company; Mr. Lawless, of Kansas City, formerly superintendent of the Metropolitan Street Railway Company, and others addressed the council.

Electric Lighting.—The electric light activity is manifest in two ways—in the establishment of new plants and the increase of old ones. At Kirksville, Chillicothe, Joplin, St. Joseph, Richmond, Cameron and Sedalia, Mo., new plants have just been established, or will be. The plant at Holton, Kan., will be enlarged. Wherever an arc light plant has been set up it is soon found necessary to add an incandescent plant. The Missourians and Kansans, in spite of the name they have for "backwoodism," appreciate a good thing when they see it as readily as any one, and the tallow dip as an illuminant for the country storekeeper has given way to the incandescent.

Telephone Matters.—There is no boom in telephone matters, but an electrician of this city, who has just returned from a visit at Ottumwa, Ia., says that the telephone plant there, which was once about the worst of the Central Union Company's, has become one of the finest in the West. A new pole line has been constructed in the alleys, with poles fifty feet in height. A new switch-board has been put in and other improvements made, while the exchange has moved into a fine new building of its own. Superintendent Smith, of the Missouri & Kansas Company here, reports that the increase in patronage has caused a slight addition to the facilities of the Kansas City Exchange, but that otherwise the company is engaged in naught but routine work.

St. Joseph, Mo.—The Wyatt Park electric railway of St. Joseph, Mo., has begun operations over a part of the line, and in a short time expects to have the whole line in operation. St. Joseph has become as important an electric railway town as Kansas City is a cable line town. It is difficult to keep track of the city's electric highways, so rapidly are new ones established. It has at least four, the Union, the Wyatt Park, the Citizens and the Frederick street. It seems to be a very popular fad for each of these roads to operate an electric light plant in connection with the railway. The Union has reorganized and reincorporated as an electric light and railway company, while the Citizens' and Fredericks street railways have arranged for a consolidation, the establishment of an electric light plant, both arc and incandescent, and the sale of the whole outfit to an Eastern syndicate. This syndicate is to enlarge all departments of its purchase and will try to include a third electric road in the deal, and will connect all so that they can be operated as one road.

Electric Roads.—A week or so ago the Kansas City & Blue Valley Railway Company was organized to construct and operate a road from the suburbs of this city to Independence, Mo., a suburban town. This enterprise is backed by such well-known capitalists as Dr. Morrison Murford, the proprietor of the *Times;* E. M. Holmes, T. J. Green, and L. E. Davidson. Then, last week, the Kensington Railway Company was organized to build a railroad connecting the small western suburban towns. The head and front of the Kensington Company is Robert Gilham, the constructing engineer of a half dozen cable railroads, including not only three or four in Kansas City, but other cities. Mr. Gilham has all along prophesied the mediocre success of electrical railways under the best possible conditions, and has declared that as far as Kansas City was concerned, an electrical railway was a foregone failure. The charter granted the Kensington company provides for the use of electric motive power as well as cable or steam, and while Mr. Gilham has not stated directly that the road will be operated by electricity, it is understood very thoroughly that Mr. Gilham is being slowly but surely convinced against his will that an electric road can be operated in Kansas City with success, and that the Kensington road will be so operated. It is very probable that the letting of the contract by the Metropolitan Street Railway Company for the construction of an electrical railway that will enter the same territory as that in which the Kensington will run, has had some effect on the cable devotee.

Thomson-Houston Work.—Mr. William J. Clark, the special agent of the Thomson-Houston electric company's railway department, was here last week, and told of the projection of an electric railway at Kearney, Neb. Mr. Clark has a personal interest in the concern, which will be constructed by the Thomson-Houston company, of course. It will begin operations with about ten cars. Mr. Clark came west with a party of Boston capitalists who wanted to see for themselves the cities and enterprises in which they had already invested or in which they had been asked to invest. Mr. Clark stopped here on his way out to confer with Mr. C. H. Rustling, the General Western Thomson-Houston agent, in regard to the proposed Armourdale line. He found Mr. Rustling had the affair well in hand, and before his return on his trip back to the East, Mr. Rustling had forwarded the contract for the line to the head officials of the company. This Armourdale line will be two and a half miles long, with an overhead construction that will admit of the operation of 20 cars.

Mr. Haygood, of the Thomson-Houston Company, who is superintending the electrical equipment of the fourteen miles of railway in Topeka, Kan., being converted from a steam railway to an electrical one by the Topeka Rapid Transit Company, was in the city last week. He had been in Des Moines, Ia., and says the electrical road being constructed there, which will probably be in operation by the time this is read, is already popular. Mr. C. H. Cone, the Kansas City agent of the Electrical Supply Company, who has also been in Des Moines, says that the road will be one of the most finely equipped in the West, and that if it is not a success it will not be the fault of the management or builders. Ordinances have already been introduced in the Council providing for the extension of the road in two directions, which will no doubt be unanimously passed after the road begins operations.

K. C. M.

ENGLISH NOTES.

LONDON, Dec. 12, 1888.

Electrical Activity.—Last week's *London Gazette* contained a long list of statutory notices of the various electrical companies which intend to apply to the Board of Trade for provisional orders. A considerable portion of the metropolis has been scheduled two or three times over, and it would seem as if London were destined to be the very centre of the present revival of electric lighting, since the number of intended applications which apply to provincial towns bears but a very small proportion to the total.

The United Telephone Company.—The United Telephone Company is gradually concentrating its wires in as few exchanges as is possible under the circumstances. This concentration naturally involves the erection of larger and better arranged switch-boards at the remaining exchanges. At the end of last month the new multiple switch-board at the Westminster exchange was brought into use, the subscriber's wires being transferred from the old board during the night without in any way interfering with the service. It is needless to say that this board contains all the latest improvements.

The Society of Telegraph Engineers.—Whether it is accident or design, I think it is a matter of regret that the change of title contemplated by the Society of Telegraph Engineers should coincide with the almost entire extinction of the telegraph engineer on the council of the society. Unless the feelings of telegraph men are considered, we run the risk of having several rival societies, each representing some special branch of electricity, instead of the present comprehensive body, representing every department of the science—a consummation which many would deplore in spite of the advantages attached to subdivision and specialism.

Dublin.—The good people of Dublin, like a large number of people in this country, while wishing to enjoy the advantages of the electric light, seem desirous of doing so without paying the additional cost. After a lengthy wrangle, and a good deal of unparliamentary language, the City Council has finally shelved the electric lighting scheme by rejecting the vote for various preliminary expenses connected with it. As, however, the Irish metropolis is both badly and expensively lighted, I do not think the last word has been spoken in this matter, especially as the scheme was only defeated by the casting vote of the chairman.

Ipswich Lighting.—The beauties of paternal legislation and consequent over-regulation of all things, is admirably illustrated at Ipswich. Here we have a well-known firm of electrical engineers, Messrs. Lawrence, Paris & Scott, the majority of the inhabitants and the local authorities all intent upon a central lighting station. This, however, is of no consequence; for when application was made for permission to lay underground wires, the town clerk gave it as his opinion that the Town Council possessed no authority to give the desired permission in the absence of a provisional order or a license from the Board of Trade. A letter was then sent to the Board of Trade to ascertain if their intervention was necessary, and at a subsequent meeting of the Town Council the following oracular telegram was received: "Question at issue of general regulations, under Section 4 of Electric Light Act, is still under consideration. Board cannot offer suggestions likely to be of use to corporation. Think, however, statutory powers should be obtained by license or provisional order." Between the Paris Conseil Municipal, which issues impossible regulations, and expects the companies to work under them, and our own Board of Trade, which is unable to interpret its powers, there is little to choose, at least as regards results. It seems, however, that Ipswich *is* to have the light, for Messrs. Lawrence, Paris & Scott intend to run their wires overhead, and apply meanwhile for a license or provisional order.

The Edison-Swan Appeal Case.—The appeal in the incandescent lamp patent case is still before the courts. On the conclusion of Mr. Moulton's arguments on behalf of the plaintiffs, Mr. Finlay commenced his reply for the defendants, and obtained leave from the court to enter upon the question of novelty. He laid stress upon the point that high resistance had long been known to be a desideratum, and that Mr. Swan formed his filaments before carbonization. He further claimed that Professor Stokes' report proved that even with the aid of all the knowledge of the present day no commercially successful lamp could be made upon the lines of the Edison specification. The following day (Friday) the defendants' case was taken up by Sir Horace Davey, who entreated the judges not to be influenced by their own decision in the previous case against Messrs. Woodhouse & Rawson, but to give full consideration to all the new and additional evidence that had been brought forward in the present case. He maintained that no lamps were made or ever had been made, except for the purposes of litigation, in accordance with the patent of November, 1879, upon which this action was based; but that the whole of the Edison lamps in actual use were manufactured in accordance with the terms of later specifications. Lord Justice Cotton plaintively remarked that he really did not know what a "filament" was, and that he failed to obtain any light upon the question from anything that the counsel said or from any evidence of the witnesses, and it seemed to him that the definition of a filament was a most important element in the case. Sir Horace Davey replied that the united wisdom of the ablest exponents of electrical science had failed to grapple with the question or to frame any generally acceptable definition of the term; but in any case he relied upon the Swan lamp, which was referred in the case as F. G. B. 1, and which was admittedly a Swan lamp of earlier date than 1879, as affording an unmistakable proof of the anticipation by Swan of Edison's alleged invention. On Monday morning Mr. Finlay resumed the argument, reviewing the history of the whole question at some length, with particular attention to the evidence which had been put in to prove the actual date of each step in advance. Toward the close of the day Lord Justice Cotton made the following remark: "The impression upon my mind is that both Swan and Edison were working at the same time and for the same end, but that Edison got out his patent first; then the question was whether he got out a good patent." At this point the court adjourned.

King, Brown & Co. v. Anglo American Brush Corporation.—In the compound winding case in which King, Brown & Co. seek to invalidate the patent held by the Anglo-American Brush Corporation, the cross examination of Prof. S. P. Thompson was resumed on Wednesday morning. Great pains were taken on the part of the counsel for the plaintiffs to induce Professor Thompson to admit that the wording of Varley's patent, however ambiguous, was nevertheless capable of bearing the interpretation of compound winding. Professor Thompson finally yielded on this point. Prof. John Perry deposed that since the date of Brush's specification nothing had been done in the way of improving constant potential machines, with the exception that we now had better knowledge of the right proportions to give the shunt and series wires. He thought that Brush's specification fully disclosed the principle of compound winding, but if Varley meant to describe compound winding then he had done it in a manner which would puzzle and mislead any electrician. From the number of terminals on the machine he believed that it was constructed for experiment rather than for actual use. Sir William Thomson gave evidence of a similar character, and went into a very closely reasoned analysis of the wording of Varley's specification with a view to show that, strictly interpreted, it would not bear the construction which it was sought to put on it and that in any case the patent could not be said to contain an adequate disclosure of principle.

Mr. W. H. Preece gave evidence on the same side. He had examined Varley's machine. It was a very complicated machine, which would have an excessive waste of power. He thought that it would have been extremely difficult if not absolutely impossible for a workman in 1876 to have made a series shunt machine from this specification. He had himself made some experiments with the earlier Brush compound-wound machines for electroplating. When the current was reduced from 300 to 20 ampères, the variation of potential amounted to 22 per cent. Mr. R. P. Sellon, electrician to the Anglo-American Brush corporation, said the patent now in question was purchased by the defenders in December, 1880, from a previous company, who had purchased it from Brush in 1879. The price paid to Brush for the English and colonial patents was £27,000, and the price paid by the present company for the English patents was £25,000. Up to the summer of 1882 witness knew of no series-shunt dynamo in the market for any purpose whatever with the exception of those supplied by the Brush Company under their patent. It was in the summer of 1883 that the Brush Company commenced to supply series-shunt machines for incandescent lighting; the machines of this character previously supplied being intended for electro-plating. It was in 1884 or 1885 that the Brush Company first discovered that their patent was being seriously infringed, and they insisted on licenses being taken out. Twenty-two of the leading manufacturers in the country had taken licenses. In cross-examination, witness admitted that the stock list of the Brush Company in 1883 showed no series-shunt machines in hand. This closed the case for the Brush Company, with the exception of the evidence of Mr. Brush himself, which is to be taken in America by commission. Counsel will afterwards be heard, and the judgment of the court will probably be given by the end of January.

THE TELEGRAPH.

Western Union Earnings.—The receipts of the test offices for the third week of December, showed an increase of $100,000 over last year.

Pennsylvania.—Action has been brought by the State against the Western Union and Baltimore & Ohio companies for consolidating in violation of the law.

Canadian Telegraph War.—A special dispatch from Montreal of Dec. 24 says: Erastus Wiman was in consultation all the morning with six of the leading counsel of the Dominion, and admitted to a reporter that the subject of his visit was to break the ninety-year contract of the Great Northwestern Telegraph Company with the Montreal and the Dominion Telegraph Company, and by which the shareholders of the Canadian companies were to receive eight per cent. dividend per annum, guaranteed by the Western Union. The directors of the Montreal Telegraph Company are

also in session discussing the situation. Should Wiman succeed in breaking the contract, the company will sue the Western Union.

The Commercial Cable Company has issued a large and handsome calendar for 1889, each sheet holding six days. The sheets are in the form of cablegram blanks, and the first one bears an imprint in the characteristic handwriting of General Manager Ward, wishing the friends and patrons of the company a happy New Year. On behalf of Mr. Mackay, in San Francisco, Mr. Ward has had the pleasure of advising the whole force of the company that the usual Christmas present of half a month's salary has been made.

THE TELEPHONE.

Bell Telephone.—The American Bell Telephone Company has 1,918 stockholders.

To Regulate Telephone Charges.—Simon Sterne, W. D. Stewart, James Talcott, Frank O. Herring and Jeremiah Fitzpatrick, the Committee on Telephones of the New York Board of Trade and Transportation, will soon prepare a bill to be presented to the legislature. It will renew the fight of the Board against telephone charges, which has been going on for four years. It now appears likely that the bill will prescribe a maximum charge of about $8 a month in New York City, without regard to the part of the city in which the telephone is used.

The Telephone in Venezuela.—The Inter-Continental Telephone Company, which holds the original concession and controls the telephone business in the chief cities of Caracas, La Guayra, Valencia and Porto Cabello and suburban districts, reports that it has gained 152 paying subscribers to its system since July 1, 1888, and has been compelled to build an addition to its central office in Caracas and increase its muitiple switch-board capacity. Mr. James A. Derrom, the general agent, arrived home for the Christmas holidays on Dec. 18, and returned on the 27th, taking with him a large shipment of instruments and supplies.

Output of Instruments.—The instrument statement of the Bell Telephone Company for the month ending Dec. 20 and fiscal year is appended:

Month—Dec. 20.	1888.	1887.	Increase.
Gross output	3,948	3,486	462
Returned	2,163	2,094	69
Net output	1,785	1,392	393
Fiscal year.	1887-8.	1886-7.	
Gross output	53,609	52,156	1,453
Returned	23,562	26,789	*3,227
Net output	30,047	25,367	4,680

*Decrease.

This makes the number of telephone instruments in the hands of licenses Dec. 20, 1888, about 408,932, against 378,885 in 1887, 353,518 in 1886, 330,040 in 1885, 325,574 in 1884, 298,580 in 1883 and 237,728 in 1882.

THE ELECTRIC LIGHT.

Marietta, Ga., is negotiating for a $12,000 plant.

Lewisburg, Tenn., is forming an electric light company.

Bessemer, Ala.—The Bessemer Electric Light Company will enlarge.

Amherst, Mass., town meeting has voted for a Thomson-Houston plant.

Rockville, Conn.—The Mather Company have put a plant in the New England mill at Rockville.

Monroe, La.—Details can be had from the mayor in regard to the proposed new electric light plant.

Barre, Vt., is to have 35 Thomson-Houston lights put in by the Standard Light and Power Company, of Montpelier.

Northampton, Mass.—Belding's silk mill is to increase its incandescent plant, and a new dynamo will soon be put in.

San Antonio, Tex.—The San Antonio Electric Light and Power Company have ordered plant for another 1,000 incandescents.

New Orleans, La.—An appropriation of $3,000 is asked for an incandescent plant for the U. S. Marine Hospital at New Orleans.

Minneapolis, Minn.—The Edison Electric Light Company, of Minneapolis, has taken out a permit for an 11-story building to cost $50,000.

McMinnville, Tenn.—Mr. D. B. Carson will receive bids on an arc and incandescent plant to be put in by a stock company now forming.

Jackson, Mich.—The Jackson Gas Company has ordered an Indianapolis Jenney arc plant of 70 lights, complete, to be installed by March 1.

Coshocton, O.—The demand for electric lights at Coshocton has increased to such an extent as to necessitate the ordering of another 30-arc light Indianapolis-Jenney outfit.

North Topeka, Kan.—The North Topeka Electric Light Company has ordered from the Jenney Electric Company, of Indianapolis, a complete plant of 600 incandescents and 50 arcs.

Cincinnati, O.—The Hauss Electric Lighting Company, of Cincinnati, has bought from the Jenney Company, of Indianapolis, three 500-light incandescent machines for central station work.

The Hoosac Tunnel.—The Westinghouse alternating plant at the Hoosac Tunnel is now finished, three 650-light machines being used. It is reported that the plant is working very successfully.

Indianapolis, Ind.—The Indianapolis-Jenney Company has recently installed a 500-light incandescent plant for the local Park Theatre, and the proprietors are extending the system to their other theatres.

Lenox, Mass.—It may be worth the while of some of our readers to note the fact that the Lenox Gas and Electric Light Company has its present office at Pittsfield, Mass., where its president and treasurer reside.

Marquette, Mich., is busily figuring on a city electric light plant and the utilization of the Dead River water power in running the dynamos. The current is to be used also for a street railway and for stationary motors.

Lima, O.—A small fire occurred on Dec. 24 at the electric light station, which also supplies current for the electric railway. Service was resumed practically the same day, when most of the apparatus was again in operation.

Weighing Power.—The Standard Light and Power Manufacturing Company, of Montpelier, Vt., have recently placed an Emerson power scale in position, by which the power required for a single dynamo or a whole plant is told at a glance.

Annapolis, Md.—The Annapolis Electric Light Company will start out with a plant of 200 arcs and 3,000 incandescents. Gen. J. B. Seth is president of the company; Dr. G. Wells, general manager; Mr. J. Hubner, treasurer, and Mr. E. S. Riley, secretary; who are directors with T. Tunis, J. F. Morrison, S. Harwood, E. A. Seth, and E. L. Tunis. The company has a contract for city lighting.

More Lights for Brooklyn, N. Y.—The Brooklyn Aldermen have authorized the placing of electric lights on Seventh, Eighth Ninth, and Marcy avenues, North Fifth, Lorimer, Ewen, Humboldt. Dean, Rodney and Keap streets, and Brooklyn avenue, 200 lights in all.

Springfield, O.—In spite of the recent crude oil fire, the Champion Electric Light Company has its plant in full operation, both arc and incandescent. Mr. C. H. Pierce is the president of the company; Mr. H. E. Chubbuck, manager and electrician, and Mr. W. A. Scott, treasurer.

Toronto, Can.—The Toronto Incandescent Electric Lighting Company formed recently has a capital stock of $200,000. Among those interested are: H. S. Howland, W. R. Brock, R. Jaffray, H. P. Dwight, Hugh Ryan, Frederic Nicholls and J. K. Kerr, who are the provisional directors.

Charlotte, N. C.—The Charlotte Electric Light Company have broken ground for an addition to their plant, and will put a 125 h. p. engine and new dynamo for incandescent lighting at a cost of about $15,000. They propose to furnish electric power. A new company with $50,000 capital stock, is being organized.

Electric Light Matters in Venezuela.—The contract with the city of Valencia for lighting the streets and public buildings has been annulled, the concessionaire having forfeited his rights by failing to furnish any lights or run any wires within the prescribed time. A new concession has been granted to C. G. Palacios for electric lights for La Guayra.

The New Edison Uptown Station, in Thirty-ninth street, started up a couple of its dynamos last week, and supplied light to the Union League Club-House, which has been awaiting the service for some time. Each of the two uptown stations is to run twenty-eight dynamos. The buildings are remarkably fine, as shown by the illustration that we published recently.

Bay Shore, L. I.—The Bay Shore Electric Light Company, Limited, has been fully organized, with Spencer Aldrich, president; W. W. Hulse, vice-president, and C. W. Vail, secretary, treasurer and business manager. These are directors with W. H. Young, J. H. Sammis, A. A. Wicks and T. G. Talmage. The capital stock is $8,000, all taken up. The plant is of the Thomson-Houston system, and the engine, boilers, etc., were furnished by the New York Safety Steam Power Company. The dynamo is a 30-arc lighter, and the engine is of 28 h. p. The Bay Shore people are enterprising, and are rapidly taking the lights. The large Methodist church has just been fitted up for electric lighting.

Quincy, Mass.—At a meeting of the stockholders of the Electric Light Company on Dec. 23 it was unanimously voted that the capital stock of the corporation be increased from $35,000 to $60,000, in order to permit the putting in of an increased plant. The statement made to the stockholders by President Pattee regarding the company's business thus far was of a most encouraging character. There is little doubt that the additional stock authorized to be issued will be taken immediately by residents. The company expects not only to supply additional arc and incandescent lights, already applied for, but also to furnish power to operate the street railways of the city, which will probably adopt electricity as a motive power next season.

APPLICATIONS OF POWER.

Austin, Tex.—Col. T. Helm proposes to start a street railway, adopting electricity as the motive power.

New York City.—The Board of Aldermen have at last voted in favor of the Julien electric cars on the Fourth avenue road.

Detroit, Mich.—A scheme is on foot to authorize the City Railway Company to run cars along Jefferson and Woodward avenues by electricity.

New York City.—Mayor Hewitt has approved the ordinance for the Julien cars on Fourth avenue, on condition that improved rails be laid down.

The New Sprague Road in Chattanooga, Tenn.—We learn from the Sprague Electric Railway and Motor Company that they have closed another very important contract for electrical equipment in street railway work. This is with President Charles A. Leyerly, of the Chattanooga Electric Street Railway Company, and calls for the entire equipment of this electric road. The Electric Street Railway Company at Chattanooga has been only recently organized, and the construction of their road will be new throughout. The line will extend over five miles of tracks, and there are a number of sharp grades which will have to be surmounted by the Sprague cars. The system used will be the regular Sprague overhead, with small silicon bronze overhead wire for a working conductor.

PERSONALS.

Mr. Charles Cuttriss, the electrician of the Commercial Cable Company, was presented on Christmas morning with a handsome silver headed cane by the force in his department.

Mr. R. F. Ross.—The marriage is announced of Mr. Robert F. Ross, the editor of *Modern Light and Heat*, to Miss Ada M. Henderson, at Moose Brook, Hants County, N. S., on Dec. 20.

Mr. Stephen Vail contributes to the *New York World* an interesting letter in which he defines the position of his celebrated father, Alfred Vail, in regard to the invention and introduction of of the electro-magnetic telegraph.

Mr. P. B. Delany has received advices to the effect that the German government has purchased a set of his cable apparatus for use on their long underground circuits, upon which the system has been undergoing trial for several months.

Mr. Zach Latshaw, of the Electrical Accumulator Company, reports a very favorable outlook for the introduction of storage batteries in connection with central stations. The Grand Rapids Electric Light Company has just taken 385 cells of the 15 A new type.

Sir William Thomson has been elected president of the Institute of Electrical Engineers of England, hitherto the Society of Telegraph Engineers and Electricians. The Institute is to be congratulated on the fact that it begins its new career under such distinguished auspices.

Mr. H. McL. Harding, the general manager of the Sprague Electric Railway and Motor Company, was married in Boston, on December 18, to Miss Florence Powers, of that city. The happy pair received a large number of presents, and congratulations from a very wide circle of acquaintance.

Mr. W. B. Somerville states that last year the Associated Press sent 327,627,407 words over its wires, and the papers took in addition 184,000,000 words of special matter. An Eastern paper is known to have received 35,000 words in a single night, and a Western paper has paid as much as $100,000 a year for its dispatches.

Mr. W. J. Baer, of Orange, an artist of considerable merit, is putting on the finishing touches of an oil painting of Thomas A. Edison, at that place. Mr. Edison is sketched while sitting in his laboratory in a listening attitude, with a telephone held in one hand close to his ear. The painting is a strong one and will be exhibited in the spring.

Mr. Wm. Maver, Jr., well known as an electrician, scientific writer, and expert official of the Baltimore & Ohio Telegraph Company, has established an office at Room 58, 31 Nassau street, as patent solicitor and electrical expert. He has associated with him in the patent department Mr. L. Scott Kemper, L. L. B., attorney and counsellor-at-law.

Mr. E. G. Acheson, the electrician of the Standard Underground Cable Company, of Pittsburgh, and member of the Institute, will read a most interesting paper before the American Institute of Electrical Engineers, on Jan. 8, at 8 P. M., on "Lighting Arresters and the Photographic Study of Self Induction." The paper is an elaborate study of the subject and will be fully illustrated by views, diagrams and experiments. The meeting will be held in the Doremus lecture room at the College of the City of New York, W. 23d st.

Mr. H. Fitz-Hatton is now in this country as representative of the sole proprietor and editor of the General Official Catalogue, to be exclusively used at the Paris Universal Exposition of 1889. Mr. Fitz-Hatton has presented his credentials to Gen. Tuck, the United States commissioner for the exposition, and may be addressed in care of M. J. Paillard & Co., 680 Broadway. Mr. Fitz-Hatton, it may be mentioned, is a personal friend of Mr. C. L. Perry, the secretary and manager of the O'Keenan Electric Manufacturing Company of this city.

MISCELLANEOUS NOTES.

The Stanley Electric Company has been incorporated under the laws of New Jersey, with a capital stock of $10,000.

The Magnetic Club.—The annual meeting of the club will be held on Jan. 10, at 5 P. M., at the Western Union building. It is proposed to increase the membership from 100 to 150.

The Storage Battery in Wisconsin.—The Milwaukee Storage Battery Company recently formed by H. H. Stafford, H. T. West and A. G. Weissert, with a capital stock of $100,000, will have the rights for the Woodward storage battery for Wisconsin and Michigan.

The Boston Electric Company has the contract for wiring the Swarts Building, Providence, R. I., for the telephone, messenger call and electric time service, and the work is now being carried out under Mr. E. C. Perkins, the agent.

Iron Poles.—The Sheet Steel and Iron Post Company, of East St. Louis, incorporated with a capital stock of $500,000, proposes to manufacture steel and iron posts for street lamps, for telegraph wires and a variety of purposes. The incorporators are Samuel N. Terry, John P. Keiser, Arthur J. Judge and Warwick H. Hough.

The American Electrical Works, of Providence, have issued a splendid calendar for 1889. The card has a beautiful engraving of an old philosopher experimenting with a magnet, and the calendar pad, copyrighted by Mr. T. D. Lockwood, gives a vast quantity of useful information, with dates, in regard to electrical events and developments. On each leaf also is a well selected passage from various sources, including the Bible, the writings of Lord Bacon, Faraday, Dr. Holmes and others. Altogether the calendar is one of the very best of the season, and one that no electrician can afford to be without.

BUSINESS NOTICES.

T. F. Hunter & Co., of 37 Church street, write us that their preference for wire of high insulation is given to the Clark rubber covered, and not to another kind, as had been stated.

The Charles Munson Belting Company have just finished belting the large Excelsior plant of Gore's Hotel, in Chicago, the order including a pair of 16-inch belts 80 feet long.

Mr. A. P. Brooke, 86 Fulton street, established in 1865 the business of manufacturing molds for glass, rubber, zinc, metal, carbon, etc., and tools, presses, etc., for glass makers. He enjoys a high reputation among primary battery people for molds for glass battery jars.

Jordan & Gottfried, 208 Canal Street, N. Y., carry a complete stock of iron and brass machine wood screws, bolt, cap and set screws, taps, dies, files, twist drills, brass and rubber tubing, rod and sheet copper, brass, German silver, steel and iron wire, shafting, tools, etc.

The John Horning Brass Foundry, 141-143 Stockholm street, Brooklyn, E. D., reports an increase of business in its composition castings for connections and contacts for dynamos, switches, resistance coils and other electrical work where perfect composition castings are desirable.

The Schenck Belt Holder and Shifter Company have put in their apparatus for the Clifton, S. C., Manufacturing Company, belts driving two 30 h. p. Edison dynamos; Alfred Dolge, Dolgeville; Thomson-Houston Company, Buffalo, N. Y., driving two machines. The Schenck Company has received the medal of excellence for 1888 from the American Institute Fair.

Electro-Medical Apparatus.—The fifty-seventh annual exhibition of the American Institute has just closed. There was a larger and better attendance than for many years previous. Among the prominent houses exhibiting this year was the Jerome Kidder Manufacturing Company, of 820 Broadway, New York. They had a very elaborate display of apparatus and instruments, and many novel devices of recent construction. They have again received the "Medal of Superiority," which for sixteen years they have never failed to receive. Every desirable feature of electro-medical apparatus and appliances is embraced in the varieties of instruments they manufacture.

The Hill Clutch Works.—The eastern office of the Hill Clutch Works, 18 Cortlandt street, New York, report a continually increasing demand for their clutch pulleys and couplings and power transmission machinery, and have recently made some very large shipments to Lowell, Mass.; North Grafton, Mass.; Stittville, N. Y.; Carthage, N. Y.; Quinebaug, Conn.; Lafayette, R. I.; Mt. Lebanon, N. Y.; Hagerstown, Md.; Paterson, N. J.; Dolgeville, N. Y., and have booked orders from the Belfast Electric Company, the Passaic Electric Light Company, the Standard Light and Power Manufacturing Company, the Petersburg Electric Light Company the Arlington Mills, Edison Machine Works, Shiebler & Co., J. B. Bowden & Co., Palmer Manufacturing Company, R. Hoe & Co., H. H. Hill, Wm. Sellers & Co., the Jarvis Engineering Company and the Fitchburg Steam Engine Company.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

EXPIRED PATENTS DATED JAN. 2, 1872.

122,389. Apparatus for Lighting Gas by Electricity; W. Klinkerfues, Göttingen, Germany. Patented Jan. 2, 1872. A gas lighting apparatus composed of a battery whose exciting liquid serves to shut off the gas escape and to yield to increased pressure of the gas.

122,437. Electro-Magnetic Apparatus for Noting Meteorological Changes; S. Chester, Elizabeth, N. J. Patented Jan. 2, 1872. The invention consists of a series of apparatuses for receiving and transmitting to distant points by telegraph the records of the direction and velocity of the wind, the condition of the barometer and thermometer and other weather indications.

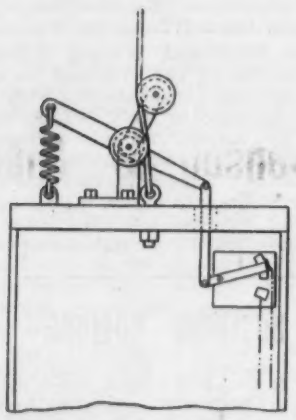
122,473 and 122,474. Improvements in Telegraph Apparatus; G. Little, Rutherford Park, N. J. Patented Jan. 2, 1872. 1. This invention relates to an apparatus employed either as a transmitter from a perforated strip of paper or for receiving upon a strip of chemically prepared paper. The improvement relates to the mechanism for bringing into action either the transmitting or receiving portions of the instrument. 2. This relates to a magnet in which one of the helices is in a shunt circuit and the other in the main line. The movement of the armature of this magnet opens or closes the shunt circuit. The apparatus is especially adapted to marking on chemically prepared paper by a stylus.

122 486. Vacuum Apparatus for Treating Diseases; S. Pasco, Delavan, Wis. Patented Jan. 2, 1872. The invention consists in one or more cups of the proper form and dimensions to embrace the human body made of compound metals that will produce an electric current. The air is exhausted by suitable means after the cup is applied to the body for the purpose of treating disease *in vacuo*, by electricity.

122,493. Continuous Action Magnetic Iron Separator. A. Ross, Montreal, Canada. Patented Jan. 2, 1872. The improvement consists in rounding off one end of the separating magnet, so that its attraction upon the ore will be continuous at a certain point in the movement of the belt carrying the loose ore.

PATENTS DATED DECEMBER 25, 1888.

394,946. Electric Switch-Board; I. H. Farnham, Malden, Assignor to the New England Telephone and Telegraph Company, of Boston, Mass. Application filed Sept. 8, 1888. This comprises the application to any form of switch-board of means for causing a continuous or periodic flow of air outwardly through the several spring jacks thereof, and since the spring jacks of horizontal switch-boards are (inasmuch as they are vertically mounted with



394,952. OVERLOADING AND SLACK CABLE STOP FOR ELECTRICAL HOISTING MACHINES.

their orifice upward) peculiarly liable to be affected by dust and fibrous accumulations due to the attrition of flexible cords, clothing and other causes, it especially comprises the application of such means to switch-boards of such character.

394,951. Telephone Apparatus; U. H. Bailey, Philadelphia, Penn. Application filed Aug. 2, 1888. The claim sets forth the invention as follows: In a central station apparatus for telephony, the combination of two or more switch-boards corresponding to different operators, switches in each of said switch-boards, corresponding in number to all of the subscribers of the central station, and normally in electric connection with the subscribers' lines, normally connecting circuits between all of the switches of all of the switch-boards which correspond to the same subscriber, a call circuit for each switch-board connecting with its subscribers, and electrically connected with the connecting circuits of said subscribers' switches, a receiver in each of said call circuits close to the switch-board, a signal battery or source of electric power, switch plugs or equivalent devices for connecting different subscribers, and switches for connecting the battery or source of electric power with the subscribers' circuits.

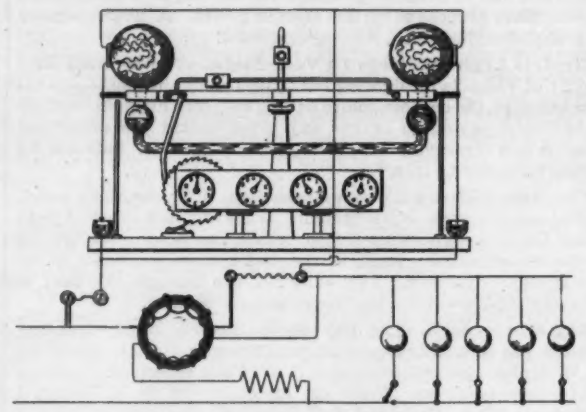
394,952. Overloading and Slack Cable Stop for Electrical Hoisting Machines; Wm. Baxter, Jr., Baltimore County, Md. Application filed Feb. 28, 1888. This invention relates to that class of hoisting machines in which an electric motor is used for actuating the hoisting mechanism, and the hoisting car or platform is elevated (by such mechanism) in a vertical or inclined hoistway; and the object is to provide any such hoisting mechanism with means for stopping the electric motor automatically when, on the one hand, the car is overloaded, or, on the other, when the car or its counter-balance is obstructed, so that the hoisting rope becomes slack or overstrained. The invention provides an electric switch which is operated automatically by the movement of some support which sustains the weight or pressure of the car, and which is adapted to yield when the car is either overloaded or obstructed. See illustration.

394,958. Battery Cell for Electric Belts; S. Colling, Oakland, Cal. Application filed Oct. 15, 1888. The object of the invention is to construct in a belt a cell or battery which can be readily disconnected from the adjacent ones, and can be easily taken to pieces for the purpose of renewing the parts. It consists of a cell or battery having its outer plate or casing made in two separate parts, each part having its ends turned, whereby one is adapted to slip into the other.

(1) 394,960. (2) 394,961. Electric Telegraphy; M. W. Dewey, Syracuse, New York, Assignor of two-thirds to Emil Laass and Chas. H. Duell, of same place. Application filed Nov. 21, 1887, and March 14, 1888. The object of this invention is to expedite the transmission of messages by the multiplex system of telegraphy, and it consists, in connection with multiplex lines, of transmitting keys arranged to be operated by one operator at one end of said lines and recording levers at the opposite ends of the said lines, and arranged with their markers in a row at right angles to the line of travel of the paper to print simultaneously side by side the several marks representing a letter or character.

394,978. Core for Armature of Dynamos; D. J. Hauss, Cincinnati, Ohio. Application filed Dec. 31, 1887. The core is made up of discs of thin metal and paper which are placed on the mandrel alternately, so as to form a core of sufficient length; and these discs are compressed on the shaft by means of washers at each end and nuts on the mandrel or shaft. The core thus formed is turned down true, and at each end a square annular gain is turned in, and the corners of the gain are clothed with flexible or elastic insulating material to receive the wires which are wrapped across the core from end to end.

394,999. Brush for Dynamos; E. W. Rice, Jr., Lynn, Mass. Application filed Feb. 4, 1888. The brush bears almost end on upon the commutator surface, and, owing to the peculiar arrangement



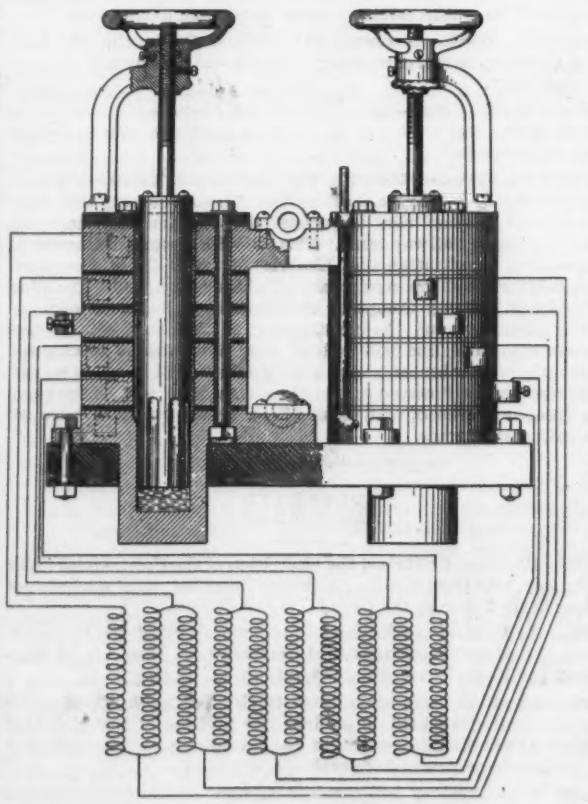
395,018. ELECTRIC METER.

of the copper strips or laminæ of which it is composed, the segments of the commutator will not injure the brush.

395,018. Electric Meter; Elihu Thomson, Lynn, Mass. Application filed Aug. 3, 1888. The invention relates to improvements in electric meters in which heating coils expand a fluid, such as air, and cause the operation of a registry apparatus. The object is especially to secure a registry when very few lamps are used, as one lamp, and at the same time give a proper registry up to twenty, thirty or more lamps, as the case may be. The invention consists in determining or regulating the proportion of current flowing in the meter to produce the difference in action by means of what is denominated a "current determining coil," placed in derived circuit to the work, or otherwise located, so as to vary in energy with the amount of work and the energy to be measured. The action of such coil is utilized through any proper devices to vary the flow of the current to the meter itself. See illustration.

395,019. Dynamo-Electric Machinery; F. Von Hefner-Alteneck and Carl Hoffmann, of Berlin, Germany, Assignors to Siemens & Halske, of same place. Application filed May 29, 1887. The armature is mounted upon the shaft, and embraces or incloses the field magnets, which are also mounted upon the shaft but loosely supported thereon. For description see THE ELECTRICAL WORLD, Jan. 14, 1888.

395,028. Flexible Sealed Cell for Secondary Batteries; M. Bailey and J. Warner, London, England. Application filed Aug. 28, 1888. The invention consists of sealed battery cells, having elastic or flexible walls, fitted with valves or equivalent devices for permitting or preventing the escape of gases, arising from or out of the contained elements, and for supplying liquids thereto or withdrawing the same therefrom. See illustration.



395,116. RHEOSTAT.

395,096. Automatic Fire Alarm, A. Watson, San Francisco, Cal. Application filed Aug. 25, 1888. Devices of this kind are most generally employed as fire alarms to give notice of an excessive increase in the temperature of an apartment, such as would be produced by the combustion of an inflammable substance in the vicinity of the device; but, while relating to the production of a fire alarm for this purpose, it is applicable, also, to other uses and purposes—such, for instance, as to give notice of the reduction as well as the increase in the temperature to which it is exposed.

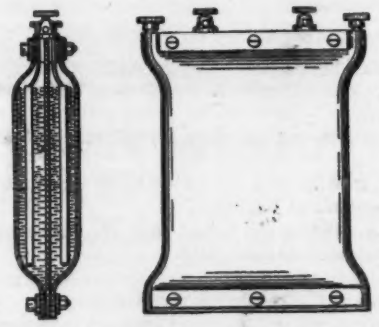
(1) 395,101. (2) 395,102. Signal Transmitters; John C. Wilson, of Boston, Mass., Assignor to the Municipal Signal Co., of Portsmouth, N. H. Application filed Sept. 3, 1888. In accordance with these inventions a series of signal-wheels or other signaling surfaces are arranged to co-operate with a series of contact pens or equivalents, one contact-pen being provided for each contact-wheel or signaling-surface. Each wheel is provided with a single projection, and the wheels are arranged on a single rotatable shaft, so that the projections will extend spirally around the shaft, or so as to form substantially a complete series around the shaft. The contact pens normally lie out of the path of movement of the signaling or contacting portions of the signal wheels, but are arranged to be thrown into such path of movement to engage the said signal wheels by a suitable selecting cylinder, which is provided upon its surface with studs or projections arranged to move two or more of the pens into engagement with the respective wheels when in different positions. The selecting cylinder is fixed to a shaft, to which is also fixed a pointer or arm which moves over or co-operates with a dial.

(1) 395,111. (2) 395,112. Electrical Alarms; Wm. A. Barnes, Bridgeport, Conn. Applications filed March 1, 1888. The inventions are designed to show the position of the point at which the circuit has been disturbed within the general area or district protected by the box. Thus, it will show a house in a certain block, for example, or the story or portion of a story in a house, or any particular locality or localities which it may be desired especially to distinguish. The operation of the indicating mechanism is automatic, and when it is combined with automatic alarm mechanism, the same disturbance which determines the sending of the alarm likewise sets the indicating mechanism into action.

395,116. Rheostat; S. Bergmann, New York, N. Y. Application filed Aug. 23, 1888. A regulator comprising a number of resistances, two receptacles for a liquid conductor, each comprising a number of terminals in electric communication with the resistances, one of the sets of terminals being connected to the resistance coils in multiple arc, and the other set in series, and means for varying the height of the liquid conductors in the receptacles to bring the resistances successively into or out of circuit. See illustration.

395,123. Circuit Controller for Dynamo-Electric Machines; Thomas A. Edison, Menlo Park, N. J., Assignor to the Edison Electric Light Company, of New York. Application filed March 16, 1888. The invention consists mainly in a circuit breaker adapted to break two circuits by the same movement, and also to break one of such circuits before the other, such circuit breaker being also provided with means for locking it when closed and for instantaneously releasing it and breaking the circuit when desired, means for preventing sparks and heating at the contacts, and means for maintaining, if desired, a constant field of force in each generator, such means being in addition to the closing of the field circuit before the armature circuit by the circuit controller.

395,137. Hotel Telephone System; H. V. Hayes, Cambridge, Mass. Application filed Nov. 5, 1888. This invention comprehends the organization in a concrete system of a number of individual electric lines radiating from a central place or point to a number of rooms or outlying points, all of which are provided with a common return wire, which serves also as a battery supply wire for use in signaling from the several rooms to the central station. At each room is provided a call-receiving bell, buzzer or vibrator, means for sending calls, a telephone and a manual



395,028. FLEXIBLE SEALED CELL FOR SECONDARY BATTERIES.

automatic switch for transferring the circuit of the direct room-line from the call-receiver to the telephone and vice versa,

395,157. Dynamo-Electric Machine; F. P. Loomis, Akron, Ohio. Application filed Oct. 30, 1887. An armature for dynamo electric generators, consisting of a number of spools, each having an iron centre spirally wound with iron wire and longitudinally wound through recesses in its ends with insulated wire.

395,163. Device for Automatically Stopping Trains; I. L. Meloon and P. S. Whiting, Lima, O. Said Whiting assignor of one-half of his right to A. L. Richmond, of same place. Application filed Jan. 14, 1888. This invention relates to a device for stopping railway trains and preventing them from running into open switches unawares. It consists principally of a device set at the side of the track that operates in connection with a lever on the train to set the air brakes and stop the train before reaching the switch.

395,207. Electric Cable Support; C. H. Bowen, Washington, D. C. Application filed Aug 17, 1888. This invention provides for supporting, insulating and grouping the cables of a system of underground or elevated lines in such manner that the respective lines or systems may be readily put up and changed or re-arranged as occasion may require, with little labor and without serious inconvenience or interruption of business. It consists of a system of cable supports composed of a main support or hanger having a removable sleeve and a series of similarly constructed supports grouped or connected with the main support.

395,215. Toll Apparatus for Producing Electric Light; D. H. Davies, of Leeds, and J. M. Tourtel, of Westminster, England. Application filed July 11, 1888. The invention has for its object to provide an apparatus (more especially designed for railway carriages and other vehicles, but applicable to other purposes) whereby a passenger or person can obtain an electric light for a given length of time by inserting a coin into the apparatus and continue the light for a longer time by successively contributing coins.

395,260. Armature for Dynamo-Electric Machinery; W. S. Belding, Chicago, Ill. Application filed March 22, 1888. This invention relates to a hollow cast-iron core for armatures for electric motors and dynamos.

395,299. Electric Motor; D. F. Sweet, Grand Rapids, Mich., Assignor to M. W. Bates, of same place. Application filed Dec. 15, 1887. It is a well-known fact that the attractive force of a magnet is mainly at its polar extremities, and especially at the corner or salient points of the same; and it also is known that the attractive points of the armature also are at the polar extremities of the same and their salient points or angles. This invention is designed to render effective these well-known laws of magnetism in the construction of an electric generator or motor, by so arranging the rotating armature and field magnets, respectively, as to concentrate the lines of magnetic force between the polar extremities of the field magnet or magnets and the rotating armatures of the machine, whereby the greatest possible amount of electromotive force is obtained.

Copies of the specifications and drawings complete of any of the patents mentioned in this record—or of any other patents issued since 1866—can be had for 25 cents. Give the date and number of patent desired, and address Johnston's Patent Agency, Potter Building, N. Y.